THE

ELECTRICAL REVIEW.

VOL. LXIX. DECEMBER 15, 1911. No. 1,777.

ELECTRICAL REVIEW.

Vol. LXIX.] CONTENTS: December 15, 1911. [No. 1777.

	Page
Guaranteed Wiring	969
Electricity and Coal Dust: An Echo of the West Stanley Explosion	970
The City Lighting	971
Single-Phase Railway Electrification	971
Suction Gas and Low Insulation	972
Simple Fault Localisation (*illus.*)	972
Notes from India	973
Correspondence :—	
Two-Wattmeter Method of Measuring Power in Three-Phase Circuits	973
The Institution of Electrical Engineers	974
The Development of Syntonic and Directive Wireless Telegraphy (*illus.*)	974
New Electrical Devices, Fittings and Plant (*illus.*)	976
Legal	979
Business Notes	979
Brazil: Its Present Conditions, and the Possibilities for Future Commercial Relations with Great Britain (*illus.*) (*continued*)	987
The Whitehaven Corporation Electricity Works (*illus.*) ...	990
Control of Centrifugal Pump Motors	991
Notes	992
City Notes	995
Stocks and Shares	997
Electric Tramway and Railway Traffic Returns	998
Share List of Electrical Companies	999
The B.H.P. Gas Engine (*illus.*)	1001
Proceedings of Institutions :—	
Automatic Reversible Battery Boosters (*illus.*) (*concluded*)	1001
Electricity in Mines	1004
Electric Lighting of Railway Trains	1005
The Future of Railway Electrification	1006
The Manchester Smoke Abatement Exhibition and Conference	1007
New Patents Applied For, 1911	1008
Contractors' Column ... ... Advertisement pages xxiv and xxvi	

THE ELECTRICAL REVIEW.

Published every FRIDAY, Price 4d.

The Oldest Weekly Electrical Paper. *Established 1872.*

TO BE OBTAINED BY ORDER FROM ANY NEWSAGENT IN TOWN OR COUNTRY.

OFFICE:—4, LUDGATE HILL, LONDON, E.C.

Telegraphic Address: "AGEKAY, LONDON." Code, A B C.

Telephone Nos.: Holborn 933; Central 4425 (Editorial only).

ALL Letters should be addressed to the Proprietors, H. Alabaster, Gatehouse & Co.

ADVERTISEMENT RATES ON APPLICATION.

The "Electrical Review" is the recognised medium of the Electrical Trades, and has

BY FAR THE LARGEST CIRCULATION

of any Electrical Industrial Paper in Great Britain.

SUBSCRIPTION RATES.—Per annum, postage inclusive, in Great Britain, 18s. 6d.; Canada, £1 1s. 8d. ($5.30). To all other countries, £1 10s.

BINDING.—Subscribers' numbers bound, including case, for 4s. each volume.

CASES.—Cloth Cases for Binding can be had, price 2s. 6d. each; post free 2s. 9d.

FOREIGN AGENTS.—New York: D. VAN NOSTRAND, 23, Murray Street. TORONTO, ONT.: WM. DAWSON & SONS, LTD., Manning Chambers. Paris: BOYVEAU & CHEVILLET, 22, Rue de la Banque. Berlin: ASHER & Co., Unter den Linden.

Cheques and Postal Orders (on Chief Office, London) to be made payable to Mr. H. ALABASTER, 4, Ludgate Hill, E.C.

THE UNIVERSAL ELECTRICAL DIRECTORY

(J. A. Berly's).

1912 EDITION IN PREPARATION.

H. ALABASTER, GATEHOUSE & CO.,

4, Ludgate Hill, London, E.C.

GUARANTEED WIRING.

IN the December issue of the *Electrical Contractor*, there is a short paper by Mr. Leonard G. Tate, the secretary to the Electrical Contractors' Association, outlining a scheme by which the E.C.A. shall guarantee the work of its members.

Such a proposition was discussed by the Central Board of the Association in June, 1910, in connection with a suggested agreement with the Birmingham Corporation. In brief, the proposal was that the Association should guarantee the work of its members on any installations carried out for the Corporation, in consideration of the Corporation placing all its installation work in the hands of E.C.A. members only.

The proposal fell through because the town clerk feared that action might possibly be taken by ratepaying contractors who were not members of the E.C.A., and who presumably did not possess the necessary qualifications for membership. Whilst fully sympathising with any movement which has for its object the maintenance of a high standard of wiring work, more particularly when such movement combines a scheme to limit that most unfair form of competition known as municipal trading, we cannot but agree that the town clerk was right.

With all due respect to the members of the Association, it does not follow that because a contractor is not a member he is incapable of carrying out good work, or that he could not find guarantors satisfactory to the Corporation for the due performance of his obligations and the integrity of his work. Mr. Tate, in his article, assumes that if any ratepayer, who is a contractor, is not a member of the Association, he is to be considered as ineligible for membership, either by reason of his carrying out bad work or because he is in a financially weak position. He even goes so far as to say that "an individual who could not obtain membership ought not to be in the business at all." Desirable as it may be that all competent contractors should join the Association, we do not think that non-membership carries with it any such stigma as is here implied, and there is no doubt that any accredited contractor who, for reasons of his own, prefers to keep outside any trade association would have a legitimate grievance against a Corporation which boycotted him on this account; and we think, in the event of an agreement being arrived at on the lines proposed—assuming it to be *intra-vires*—the E.C.A. would have to indemnify the Corporation against any actions which might be brought against it by aggrieved contractors.

Touching on the broader aspect of the question—viz., the guaranteeing of contracting work done for the public generally—Mr. Tate considers that this presents greater difficulty, as it is impossible to enter into an agreement with the public.

He therefore suggests the formation of a guarantee fund, to which members desiring a guarantee should subscribe a sum based on a percentage of their turnover; or alternatively, that all members should subscribe a definite amount to the fund. Members would then be able to inscribe on their tenders that the quality of the work estimated for was guaranteed by the Electrical Contractors' Association, who undertook to make good at their own expense any defects that might be proved. Nothing is said in the article as to the limit which is to be set on the Association's liability, but an Editorial comment suggests £50 as the limit on any one job, and £200 on any number of jobs carried out simultaneously by one contractor.

What the proposal really amounts to, so far as the customer is concerned, is a scheme of insurance against defective work, and it seems to us that the matter will have to be treated strictly on the lines of an insurance business. For a definite annual payment the Association could probably insure the whole of the members' work with some recognised insurance company, which would, no doubt, place a limit on the amount of indemnity payable in respect of any one installation. We need not pursue this point further, as the details of insurance policies have been thoroughly sifted and standardised by those companies which specialise in this class of business.

There are several questions which naturally arise out of the proposal: Who is to be the authority or Court of Appeal who shall decide whether or not the work is satisfactory or up to specification? Who is to draw up the standard specification with which the work shall comply? Will the customer be satisfied with a limited insurance? These are among the questions which suggest themselves.

As matters stand at present, all that a customer has to do before giving an order is to stipulate that the work shall meet all the requirements of his insurance company, and, on completion, the installation is insured as part of the building. This is, generally, only an insurance against fire, and not against defective work or materials, but an insurance inspector who knows his work would call attention to anything obviously defective.

We do not suggest that nothing further is needed, but we are here trying to look at the matter from the customer's point of view. On the other hand, there are many people who regard electricity as dangerous—a feeling which has been intensified by irresponsible writers to the daily Press, who attribute every fire of doubtful origin to the "fusing of an electric wire." To such people, a guarantee of good and safe work would, no doubt, carry weight, and a contractor whose work was guaranteed by a trade association would undoubtedly have a pull over a non-member whose tender did not carry the official *imprimatur*.

On the question of inspecting the work and deciding questions in dispute, Mr. Tate is silent; but the *Electrical Contractor*, in its editorial comment, suggests the appointment of a member of the Association who shall have been a member for, say, five years, the cost of the award to be borne by the party against whom the decision is given. This is a matter which will require to be regarded from more than one point of view. There is the view of the contractor who objects to a competing contractor sitting in judgment on his work, and the view of the customer who may regard a member of the E.C.A. as a biased judge and may prefer an independent expert who is not connected with any trade association. He may, and some no doubt would, desire to have a voice in the appointment of the referee. If we may venture a suggestion on this point, it is that the Association should invite a number of outside experts, that is to say, consulting engineers who are in constant touch with wiring work, to allow their names to be placed on a list of assessors from which the interested parties might choose. In the event of no preference being shown by the parties, the president for the time being of the E.C.A. might nominate a gentleman from the list.

With this suggestion we leave the matter for the present; we shall watch with much interest the further development of the idea.

ELECTRICITY AND COAL DUST: AN ECHO OF THE WEST STANLEY EXPLOSION.

One of the most important criticisms that has yet been uttered on this question was made by Mr. W. C. Blackett, an eminent mining engineer in the North of England, on Saturday last, during the discussion on Prof. Thornton's paper on "Experiments on Liquid Mixtures for Laying Coal Dust," at the meeting of the North of England Institution of Mining and Mechanical Engineers.

In this paper Dr. Thornton described the wetting action of several liquid mixtures sprinkled upon coal dust with a view to rendering it harmless, and thus preventing it from exploding or propagating an explosion of gas or coal dust which had once been ignited, and undoubtedly the paper was, from an academic point of view, a useful contribution to the subject. We say academic because, unfortunately, it would be impossible to use most of the liquid mixtures described, as they themselves were of a more or less inflammable nature, and, moreover, there is the very practical question whether "wetting" the dust is the best or the right way to deal with it. The object of the paper, however, was an honest attempt to solve a difficult problem with the idea that, if once coal dust were rendered innocuous, one very serious obstacle to the use of electricity in mines would be removed, thus further opening the way for its development, and every credit is due to the author for his effort in this respect.

The discussion was opened by Mr. Prest, who said that in his opinion it was utterly impossible to stop the formation of dust or to remove it effectively, and he thought that instead of trying to treat the dust, attempts should be made to produce an explosive that would not ignite coal dust. This is all very well, but Mr. Prest overlooked the fact that it is not always a "blown-out shot" that initiates an explosion. Frequently it is a (so-called) "safety" lamp.

Mr. Blackett—who was one of the experts engaged in investigating the West Stanley explosion—followed, and pointed out that it was not always the "explosive" that caused an explosion in the pit, but sometimes a lamp, and sometimes, although such a statement seemed very ridiculous, sparks from falling stones. In fact, an explosion occurred in a mine—a very serious explosion—when there was no-one in it, and further, it was not caused by electricity. He thought too much was being made of the danger of electricity, and, indeed, "he was becoming afraid of Dr. Thornton, who had struck the most staggering blow electricity in mines had ever received," and who undoubtedly was the cause of the restriction about to be passed into law, regarding the use of electricity in mines where more than 1¼ per cent. of gas was present. It was all very well to carry out experiments in a laboratory, and derive certain data therefrom, but as he had only recently proved with the Holmes-Ralph gas-detecting apparatus, which, while it worked perfectly in "coal-gas," gave absolutely no indication whatever of "firedamp" in the mine, it was most important that before statements based on surface or laboratory experiments were made, they should be verified, where that was possible, by actual practical experience in the pit. Mr.

Blackett then referred to the West Stanley explosion, where Dr. Thornton was called in by the miners' representatives as their expert investigator. The former described how he first of all suspected electricity, and made an expensive and exhaustive search to see if he could find any indication of an initial disruption of any electrical apparatus or cable likely to cause the explosion, but found none, and he gave it as his opinion that the explosion was started by a heated roller spindle causing smouldering of the wood carriage or coal dust, in conjunction with the accident to the train of tubs and the raising of a cloud of dust—dust, moreover, of a highly susceptible and inflammable nature. This opinion was supported by his *confrères*, and no one except Dr. Thornton ever suggested that the explosion was caused by electricity. It may be remembered by those who followed the investigations that Dr. Thornton gave as his theory, which he attempted to prove by experimental demonstration, that coal dust flashed or short-circuited across a pair of electrical terminals, thus starting the explosion; this theory was afterwards followed up by a series of experiments, the results of which were communicated to the Institution of Mining Engineers in another paper. All of this has undoubtedly largely contributed to the present legislation. As was pointed out by Mr. Blackett, the danger of such a theory propounded by a man of Dr. Thornton's standing was that it was appreciated by outsiders as coming from one who was wholly unbiased, whereas the opinions of such practical men as Mr. Blackett were looked upon as more or less prejudiced, and the whole of the objections of Sir Arthur Markham and the miners' representatives were based upon the academic evidence of Dr. Thornton.

The point of importance, however, is that hitherto it had been assumed that fire-damp was identical with ordinary coal gas, and what took place in an experiment conducted with coal gas would take place at the coal face. There is, however, a distinct difference, as fire-damp is marsh gas, and what occurred with the Holmes-Ralph gas detector may equally apply to the experiments of Dr. Thornton, and Mr. Blackett on Saturday challenged the Doctor *to prove that the West Stanley explosion was initiated in the way he had suggested in his evidence.*

We are in complete agreement with Mr. Blackett. It has yet to be proved that electricity—even at the face of a fiery mine—constitutes a danger. We can admire the work done by Dr. Thornton, as undoubtedly he was prompted by the highest of motives, and the unfortunate part is that the results of his work have been seized by a pack of faddists, and distorted by them in order to gain their own ends. The miners' representatives are wrong, Sir Arthur Markham is wrong, the Departmental Committee was also wrong in assuming that there were some parts of a mine where electricity would be dangerous. The whole question ought to be carefully and fully reinvestigated, but by men who have a thorough practical knowledge of electricity and mining. By all means let us have theory propounded, and demonstrated by experiments, but where the well-being of an industry is in question, and especially such a basic industry as coal-mining, let us not forget practical considerations, or, in attempting to protect the individual from a *supposed* danger, cause unnecessary suffering to thousands.

An old saw informs us that "an ounce of practice is worth a pound of theory," which is truer as regards mining than any other industry, and it will be a bad day for the world at large when the mining industry is to be regulated by legislation based on theory alone. We sincerely trust that the remarks of Mr. Blackett will receive the attention they deserve, that the powers that be will seriously reflect as to whether the evidence before them is sufficiently conclusive and positive to warrant the very drastic measure about to be put into force, and that they will at least leave open the door for advancement and prosperity.

The City Lighting.

In our last issue we briefly reported the proceedings of the Court of Common Council of the City in connection with the illumination of the City streets. The City Fathers have been sitting on this important matter for some years, and we confess to a certain amount of disappointment with the commonplace result of their labours.

The situation as regards the rival illuminants, gas and electricity, remains much as it was; of the 56 miles of main streets, the City of London Electric Lighting Co. will continue to light 12, and the Gas Light and Coke Co. the other 44, but greatly improved illumination will be given, and at less cost.

It is a thousand pities that the Corporation in dealing with a matter of such vital interest to the community did not exercise some of that exquisite discrimination and free-handedness which has earned for them unstinted regard in far less praiseworthy directions; and that they could not rise above mere £ s. d. when considering the lighting of the exceedingly congested streets of London City, of all places.

The adequate lighting of main thoroughfares is of such far-reaching importance that such items as mere candle-power and cost are really only secondary matters as compared with the result to be obtained, and only the best is really good enough, especially in the City.

For once in a way we can endorse the opinion of our contemporary, the *Gas World*, that "the guiding principle in arriving at a decision has not been the relative merits of the rival lights, but expediency." Had it been otherwise we cannot conceive of any sane body of councillors agreeing to saddle the ratepayers for ten years ahead with an antique system of lighting in which a large proportion of the lighting points require individual lighting and extinguishing every 24 hours.

Such a system is obviously far too inflexible for the variable climatic conditions of the City, where, owing to the traffic conditions, adequate lighting, either by natural or artificial means, at all times, is a *sine qua non*, and if, as the *Gas World* assures us, gas people would have preferred to have the contest decided on merit, we imagine that the electrical people would have jumped at the chance of repeating their Holborn tender.

Single-phase Railway Electrification.

There is an unusual fascination in the spectacle of the eloquent consulting electrical engineer leading on the half-reluctant railway director to higher things, which it is difficult to resist. Thus, Mr. Philip Dawson, in a recent paper before the Royal Automobile Club, after invoking the good example of our American and Continental friends in railway electrification, concluded by outlining a definite scheme of single-phase traction between London and Brighton—the full details of which, and possibly its adoption, may be matters of public interest in a few months' time.

Apparently it is proposed to inaugurate a frequent high-speed electrical shuttle service on the London-Brighton route, which will be fed by frequent motor-coach services on branch lines, and will take over the steam-hauled trains from important centres such as Eastbourne, Portsmouth, &c., at convenient points. With non-stop journeys of 45 minutes, and journeys, with intermediate stops, of 60 minutes, as forecasted, the sceptic with a past knowledge of this company's little ways may be pardoned for rubbing his eyes. But the presence of Lord Bessborough, the chairman of the company concerned, and of several of its leading officials, stamps the proposition as other than the chimera of an electrical enthusiast.

Mr. Dawson describes the scheme—if it matures—as epoch making; after a study of the company's time-tables and a liberal allowance for their non-observance in practice, we are inclined to agree with him whole-heartedly.

The Brighton Co.'s prospective doings, of course, closely affect us, but it is interesting also to turn to Australian railway matters, in connection with which we note that the Victorian Government has instructed Messrs. Merz and McLellan to prepare alternative specifications for direct and single-phase working of the Melbourne suburban system, involving possibly 200 miles of railway. It is understood that this electrification has been definitely decided on.

D

SUCTION GAS AND LOW INSULATION.

By LEONARD HARDING.

There have recently been communications to this paper dealing with low-insulation troubles on dynamos driven by gas engines supplied with suction gas. The question has also been mentioned in the 1910 report of Mr. Michael Longridge, who, as chief engineer to the British Engine, Boiler and Electrical Insurance Co., Ltd., has had a very large number of these cases brought to his notice. As the trouble, therefore, is an urgent one, it has become necessary to investigate the cause.

The general experience, and that of the above company, seems to be that conducting surfaces are formed at the back of the commutator, causing "grounding," but very seldom complete breakdown. There have, however, been cases of breakdown which were attributable to this cause. In one case a deposit was taken from the back of the commutator, which, on analysis, was found to consist of 70 per cent. of free and combined copper, together with 19 per cent. of free oil, the remainder being oxidised oil, cotton, mica and dirt. Some of the copper was combined as sulphide and sulphate, and there was also a quantity of sulphur in combination with the organic matter. No doubt a considerable amount of this deposit was due to dust from the wear of the commutator, carried to the back by windage, but the interesting feature to notice is the presence of sulphur.

It has been thought that if these troubles were due to the gas plant, then valuable information might be obtained by chemical investigation of the atmosphere. The result of such investigation has shown that where these low-insulation troubles are experienced there are comparatively large quantities of sulphuretted hydrogen (H_2S) present in the engine room and gas-plant house; this may account for the sulphur in the deposit mentioned. Water dissolves four times its own volume of sulphuretted hydrogen (H_2S), and this gas, when moist, is oxidised to sulphuric acid (H_2SO_4) on warming. This reaction may be the secret of all these low-insulation troubles, as the oxygen in the air is sufficient to cause the oxidation.

In one case it was found that the machine which always showed the lowest insulation was the one that was idle the most. This may be due to the fact that it had a better chance of taking up moisture, and, consequently, the absorption and subsequent oxidation of the gas would be aided.

The deleterious effect of this gas is accentuated by the poor arrangement for ventilation which usually exists in the majority of such engine rooms. The gas-plant house is generally next to the engine house, and communicates with it by a door. In some cases the engines are directly opposite this door, and, when running, the air is drawn from the gas-plant house by the fan action of the fly-wheel over the machines, and may be dispersed out of the windows or doors, or up the rope race. In a few cases the engine room depends entirely on the gas-plant house for its ventilation. The result is that any impure air in the latter is drawn into the former, especially as the outside door of the gas-plant house is usually kept often. In addition to this, there is more often than not a leak on the engine cylinder, from which gases and oily vapour escape into the room.

Wherever these troubles are experienced the switchboard is also affected. The unvarnished copper bolts and fittings become blackened, and the brass becomes coloured with spots of white powder and chocolate-coloured patches. Upon analysis, all these deposits and patches have been found to be sulphides and sulphates of copper and zinc. Bright strips of copper left in different parts of the engine and gas-plant houses, when examined after a week's time, were found to have become very dark with copper sulphide, the strip from the gas-plant house being very much worse than the others.

In cases where a paint containing lead has been used for painting the gas plant, the peculiar fluorescence associated with lead sulphide can be seen over large areas, and owing to blackening, it has become necessary in some cases to repaint the plant very soon after its installation.

Although the low insulation of machines has been the predominant question with engineers, there is another aspect which is very much more important—that is, the question of injury to the health of the people working in these atmospheres. Sulphuretted hydrogen is a poisonous gas, a very small quantity of which will produce a feeling of sickness and headache. According to Thorpe, $\frac{1}{200}$th of the volume of this gas in any room is sufficient to kill a horse, this quantity having no effect on cold-blooded animals. The writer has been affected with the gases in various engine rooms, leaving the place, as a rule, with a slight feeling of sickness and headache.

It would appear, then, that stringent legislation is required in connection with the use of suction-gas plants. Although the factory inspectors insist upon efficient ventilation in a gas-plant house, they do not appear to have considered the possibility of injurious fumes being present in the engine room. There can be no doubt that efficient ventilation would remove the trouble, but it is important to remember that the fresh air should be drawn in from the top and the foul air drawn out by fans or other efficient means from the bottom. This would be, however, an expensive and second-rate remedy, the real remedy being the removal of the injurious gases before leaving the scrubber. Unless this is done, it is essential to fill up all spaces between copper and iron with several coatings of a reliable "anti-sulphuric" enamel. This, combined with efficient downward ventilation, should go far to remove the deteriorating effects hitherto experienced.

As mentioned above, the necessity arises for the more perfect scrubbing of the gases before passing to the engine, whereby all injurious impurities may be removed. It might be a possible and an effectual remedy to insert a layer of ferric oxide or lime inside the existing scrubber, which would very likely remove the cause of low insulation and impaired health. The use of ferric oxide would not be expensive, as the ferric sulphide formed could be revivified upon exposure to the air according to the following equation—

$$2\,Fe_2S_3 + 3\,O_2 = 2\,Fe_2O_3 + S_3.$$

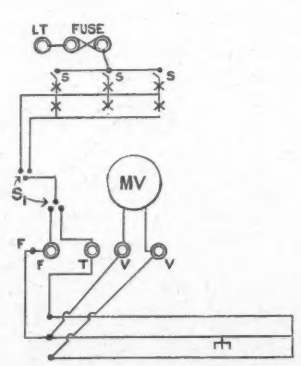
Thus a great evil might be removed at a small expense.

SIMPLE FAULT LOCALISATION.

By H. H. JOWERS.

Simplicity should be the keynote of fault localising, and the writer here describes a few simple methods which have been found to give very satisfactory results. The methods given are for direct-current networks.

The first point a mains engineer has to decide is which section of the network is faulty; the method to be



used for this depends chiefly upon two points, the magnitude of the fault current and the equipment of the switchboard. Should the fault current be large enough to give a clear indication on the feeder ammeter above the ordinary fluctuation of the load, then it is an easy matter quickly to divide the distribution fed by that particular feeder on to other feeders, and then localise the section; but when the current is only small, say under 10 amperes, it becomes a more difficult matter. If the switchboard is equipped with a test bar, &c., as described in the writer's article in the Elec-

TRICAL REVIEW, Vol. LXIX, No. 1,768, page 598, it is not a very difficult matter to localise the section, but should the switchboard not be so equipped, the following method has been found to be successful in finding the district in which the fault lies.

Take, for example, a fault of 8 amperes; this is too small to be noticed on the feeder ammeters. Take a portable low-reading ammeter reading to about 10 amperes, put this between the neutral and "earth" at the station "earth," and take a note of the readings of the two ammeters, that is, the portable ammeter and the ammeter permanently in the "earth" circuit; this is done to obtain the relative readings of the instruments. The leads of the portable ammeter can then be adjusted so that the readings on the two instruments are equal, that is, half the leakage current will flow through each. The portable instrument is then taken out and connected between the neutral and earth at the feeder points or disconnecting boxes; the leakage current will divide into two paths, one returning to the permanent "earth" and the other to the temporary "earth." When this temporary "earth" is nearest to the fault, the maximum reading is obtained on the portable instrument, thus giving the district in which to seek for the fault.

The same method can be applied for localising neutral faults, but in this case a resistance is placed in circuit with the portable instrument to give, say, a current of 10 amperes when connected between an outer and "earth"; then, when the minimum reading is obtained on the earth ammeter at the works, the portable instrument is nearest the fault.

Having found the faulty section by one of the above methods, we next proceed to localise the exact point of the fault. For this purpose the writer has made a small portable board, as shown in the sketch diagrammatically connected up to the faulty main. The three mains are short-circuited at the far end, the faulty main always being connected as the centre wire of the three, in order to save any calculation for the short-circuiting strip. A connection is next made from a live main to L.T.; the current then flows through the fuse and resistance, the latter being composed of six lamps—two 8-C.P., two 16-C.P. and two 32-C.P.; these, as is seen by reference to the diagram, can be used either as three in parallel or three sets in series, or one in series with three; it is found that by moving the lamps a very varying resistance can be obtained. The current passes through F, and a reading is obtained on the millivoltmeter; the current is then switched over by the change-over switch S_1 and passed through T; then if the readings on the voltmeter are V_1 and V_2 respectively and the length L, the distance of fault from testing end is $\frac{L}{V_1 + V_2} \times V_1$.

Should the main only be a two-wire distributor, the same board applies, but in this case to obtain reading V_2, the short-circuit must be removed to the testing end and the test panel taken to the other end of the main. The whole apparatus is very simple and conveniently handled, the board only measuring 28 in. × 14 in.

NOTES FROM INDIA.

[FROM OUR SPECIAL CORRESPONDENT.]

November 23rd, 1911.

Delhi Durbar Lighting.—The King is almost with us now, and the camp lighting is all but ready. It is estimated that there are about 40,000 lamps connected in all. Arc lighting was a feature of the 1903 Durbar, but this time arcs are conspicuous by their absence; there are only a few camps lighted with flame arcs.

The most remarkable electrical feature is, perhaps, the high candle-power metal lamps: these range from 1,000 down to 16 C.P., and, from a lighting distribution point of view, are a complete success.

As was anticipated, the view of the 16 square miles of camps with their lights all ablaze at night is truly magnificent, and probably unique in the history of electric lighting.

From the Flagstaff Tower one can see the whole camp, from the King's quarters at the foot of the Ridge to the military camps five miles off, all the area between for a breadth of over three miles being brilliantly lighted. Any lighting other than electric is prohibited in camps on account of the danger of fire. The insides of tents being very inflammable, the utmost precautions are necessary; even then, there is an ever-present danger of fire through the carelessness of native servants and others.

Mr. G. E. Barlow, Messrs. Belliss & Morcom's Indian agent, has been temporarily appointed as mechanical engineer in charge of the power-house steam plant during the Delhi Durbar. Mr. K. Preston, of Messrs. Siemens Bros., has been temporarily appointed as electrical engineer in charge of the power-house electric plant during the event. Mr. J. S. Pitkeathly, electrical inspector to the United Provinces, is in supreme charge; his assistants are Captain Barker, R.E., Lieutenant Trench, R.E., and Mr. J. Francis Scott.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

Two-Wattmeter Method of Measuring Power in Three-Phase Circuits.

In Mr. Ogley's article a balanced three-phase system has been assumed. The two-wattmeter method is also suitable for measuring power in three-phase circuits where the phases are unequally loaded. This may be proved as follows:—

Assuming a star connection, let i_1 i_2 i_3 be the currents and v_1 v_2 v_3 the volts in each leg of the star at any instant. The voltage impressed on meter "A" is $v_1 - v_2$, and the voltage impressed on meter "B" is $v_3 - v_2$.

The reading of wattmeter A $= i_1 (v_1 - v_2)$,

The reading of wattmeter B $= i_3 (v_3 - v_2)$,

The sum of the readings $= i_1 v_1 + i_3 v_3 - v_2 (i_1 + i_3)$.

As at any instant the sum of the currents is zero, $i_1 + i_2 + i_3 = 0$, so that $i_1 + i_3 = -i_2$.

Substituting $-i_2$ for $(i_1 + i_3)$ in the above, the sum of the readings becomes $i_1 v_1 + i_2 v_2 + i_3 v_3$, which is, of course, the total power in the circuit.

It follows from the calculations in Mr. Ogley's article that, if two separate single-phase watt-hour meters are used to measure the energy supplied to a balanced three-phase circuit, one of the meters will run backward when the power factor of the whole circuit is less than ·5 (cos 60°). It is generally more convenient to use a polyphase watt-hour meter, consisting of two single-phase elements connected to a common spindle and integrating on a common dial or set of dials. When this arrangement is used, one element tends to run backward when the power factor of the circuit is less than ·5, but as it is connected to the same spindle as the other element, the effect is to retard the other element, which, otherwise, would run too fast and record more than the total energy of the circuit.

With regard to the method of obtaining the power factor from the ratio of the readings of the two wattmeters, it may be pointed out that this method is used in power-factor meters of the "Weston" type. In these instruments the movable system carrying the pointer consists of two circular pressure coils fixed on the same staff, and in planes at right angles to each other. There is a fixed coil carrying the current of one of the leads (say No. 1). One of the pressure coils is connected across leads 1 and 2, and the other is connected across 1 and 3.

A convenient equation for obtaining the power factor from the ratio of the wattmeter readings is—

$$\cos \phi = \frac{R + 1}{2\sqrt{R^2 - R + 1}}$$

where R is the ratio W_1/W_2 or W_2/W_1. This is derived as follows :—

$$W_2/W_1 = R = \frac{\cos(30^\circ + \phi)}{\cos(30^\circ - \phi)},$$

$$R\cos(30^\circ - \phi) = \cos(30^\circ + \phi),$$

$$R(\cos 30^\circ.\cos\phi + \sin 30^\circ.\sin\phi) = \cos 30^\circ.\cos\phi - \sin 30^\circ.\sin\phi,$$

$$(R - 1)(\sqrt{3}\cos\phi) = (R + 1)(-\sin\phi).$$

Squaring :

$$(R^2 - 2R + 1)(3\cos^2\phi) = (R^2 + 2R + 1)(1 - \cos^2\phi),$$

$$4R^2\cos^2\phi - 4R\cos^2\phi + 4\cos^2\phi = R^2 + 2R + 1,$$

$$\cos^2\phi = \frac{R^2 + 2R + 1}{4(R^2 - R + 1)} \therefore \cos\phi = \frac{R + 1}{2\sqrt{R^2 - R + 1}}.$$

It should be noted that the ratio may be either W_1/W_2 or W_2/W_1. For example, let the readings of the two meters be 10 and 5 ; R may be taken as $10/5 = 2$, or $5/10 = \cdot5$. Substituting either $\cdot5$ or 2 in the above equation gives the power factor as $\sqrt{3}/2$, or cos 30°.

The power factor may also be obtained with a fair degree of accuracy from the readings of two watt-hour meters. The energy recorded by each meter over a short period when the load is steady, is noted, and from the ratio of the readings, the power factor is calculated as above.

John W. Black.

Glasgow, *December 11th*, 1911.

The Institution of Electrical Engineers.

I desire, through the medium of your columns, to express what I am unable to state, either directly or by representation, at any Institution meeting, local or otherwise, viz., my strong disagreement with the proposals now being considered by the Institution of Electrical Engineers, which vitally affect the whole of its members. In doing so, it is well to bear in mind the sound advice given in the last issue of the *Engineer*, and to refrain from mere abuse of members who have voluntarily given much time and thought to the thankless task they have undertaken. Of the criticisms which have appeared, many may be dismissed as mere abuse, but of the rest none express more clearly the situation as regards provincial members than that of Mr. T. Roles, of Bradford. I have been for the last 8½ years, since I left a London station, out of reach of any Institution centre, and have often asked myself, What do I obtain in return for my annual subscription? I obtain the Institution *Proceedings* (whose value I fully appreciate), and the right to put the mystic letters A.M.I.E.E. after my name. As regards this, there is nothing to prevent me from using the letters E.E., after the style of many civil engineers, who, unable to belong to their own Institution, style themselves C.E., and I venture to say that 99 out of 100 of the general public will not appreciate the difference, as I know to be the case with the civil engineer C.E. Many engineers have expressed in your columns, from time to time, their desire that the Institution should afford them some protection in cases of illegal and unfair treatment by employers, and that there should be some attempt to get a minimum salary basis, especially for central station posts. If this were done, there would be some real value in membership of the Institution.

It is now, and always has been, my feeling, and that of many other provincial members, that the Institution is managed by London members mainly as a club for the benefit of London members only, whilst mainly supported by provincial members, as Mr. Roles's figures conclusively show. I, for one, cannot easily afford any increased subscription, but should be willing to pay more if I were able to attend London meetings, and have the use of the London premises and library, now denied to me, and so get value for my outlay.

It is most desirable that the representation of London and district members within 50 miles of London, and of provincial members outside that area, should always be in strict proportion to their numbers or the value of their subscriptions, these members being elected by provincial or London votes as vacancies occurred.

If the Council of the Institution would first apply themselves to the ways and means of enhancing the value of the Institution to approach that of the Medical, Teachers, Organists, or other Associations, then members would not be so unwilling to contribute more.

In conclusion, I beg to say that in my case (as doubtless in many others) if provincial subscriptions are raised it will be a matter for consideration whether, in the future, I shall not be well advised to sign myself M.I.Mech.E. and E.E., as I am qualified (but not yet entitled) to do, instead of as at present.

B. Sankey, A.M.I.E.E. A.M.I.Mech.E.,
Borough Electrical Engineer.

Whitehaven Corporation
Electricity Works,
December 5th, 1911.

THE DEVELOPMENT OF SYNTONIC AND DIRECTIVE WIRELESS TELEGRAPHY.*

By S. M. POWELL.

Syntony and its Limitations.—As the number of wireless telegraph stations has increased, the unconfused exchange of messages has become more and more difficult. All stations necessarily employing the same transmission medium, wireless telegraphy amounts to telegraphy over a single line common to all. Efforts have therefore been concentrated on the development and improvement of syntonic working, *i.e.*, means by which the waves emitted by any desired station may be received to the exclusion of all others. Immunity from "external" interruption has been sought for and obtained by the application of the phenomena of resonance, while interesting results, but only partial solutions of the problem, have been obtained by the use of "musical" sparks and by "sustained" trains of waves (particularly such as are emitted by the Poulsen arc).

Whatever the degree of syntony or sharpness of resonance, it is always possible for any station within the effective radius of the waves to tune its apparatus to receive the signals, and if it so wishes then to send out "blocking" signals," of the same wave length, to destroy effective communication between the two stations originally conversing.

The best syntony obtainable can never ensure secrecy or prevent deliberate interruption of signals.

By a suitable arrangement of lenses and mirrors, it is possible so to conduct optical telegraphy that the signal beams cross each other in any manner and degree, and yet each message can only be received by the appropriate station. That such working is not possible with Hertzian oscillations, is entirely due to the long wave length of the latter employed. Whereas a mirror only a few mm. square produces regular reflection of light, a mirror several km. square would be required to produce regular reflection of electrical waves (for the wave length of luminous radiations is a fraction of a micron, but that of Hertzian waves is at least several hundreds of metres). Oscillations of less than 300 metres wave length are seldom employed in radio-telegraphy, and for such the phenomena of "diffraction" become of prime importance.

It is by totally different means that the problem of "directive" wireless has been partially solved, and the results of the researches on this subject are interesting in themselves, and doubly interesting because of their importance in navigation.

Directive Wireless Telegraphy. Fleming and Marconi.—The first experiments on "directive" wireless telegraphy were carried out by Marconi and Fleming, and originated in a fortuitous observation, by Marconi, that asymmetric radiations were obtained from a bent aerial—arranged as in fig. 1—with a short vertical and long horizontal arm. The maximum effect is observable in direction BA, opposite to that in which the horizontal arm points.

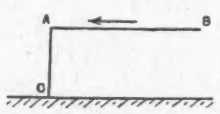


FIG. 1.

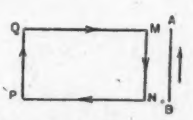


FIG. 2.

It may be understood how such asymmetric action is set up by regarding CAB (fig. 1) as equivalent to a closed rectangular oscillator (fig. 2), together with an open oscillator BA. If the currents flow as shown at any particular moment, and if the strengths of these currents be equal, and their oscillations always in phase, the effects of NM and AB will clearly cancel, and the system as a whole will radiate most strongly in the direction MQ.

* Abstract compiled from paper read by Lieut. Tissot at the Conf. de la Technique Moderne.

Just as a body, which is a good radiator of heat, is also a good absorber, so an aerial, which emits radiations freely, receives them readily, and a directive aerial (fig. 1) is also a directive or asymmetric receiver—*i.e.*, receives radiations coming in the direction A B more readily than those coming from any other direction. The most selective and the most powerful working with bent aerials is, therefore, obtained when the sender and receiver are arranged as in fig. 3.

By using a thermo-electric detector in the receiving aerial, Fleming obtained diagrams showing the energy received by a

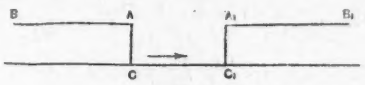


FIG. 3.

straight vertical aerial disposed in various positions relative to a bent aerial. These diagrams have always the general form shown in fig. 4; maximum radiation occurs in a direction 00°, opposite to that in which the bent aerial points. A minimum, about one quarter as great as the maximum, occurs in the direction 180°, and two absolute minima occur in directions 110° and 250°. The asymmetry of this radiation curve is the more marked the greater the ratio of the horizontal to the vertical length of the antenna.

With a bent aerial (vertical height 3 m., horizontal arm 50 m.) at Mullion, Cornwall, signals were only received from the Scilly station—85 km. away—when the horizontal arm of the receiver made an angle of less than 20° with the direction of that of the transmitter. This limited range, though too great to enable bent aerials to be regarded as truly "directive" in action, still proves that their use concentrates the emitted radiations to a marked extent. It is for this reason that the large trans-Atlantic stations at Clifden and Glace Bay have bent aerials composed of 60 parallel horizontal wires 330 m. long, suspended 100 m. above ground. The concentration obtained is far from complete; indeed, the trans-Atlantic signals may be received in very different directions from that connecting the two stations directly concerned, and, moreover, at quite long distances from the latter—*e.g.*, in the Mediterranean.

"*Interference*" *Methods.*—An alternative means of securing directive working employs the phenomena of "interference." Suppose two vertical aerials be arranged as in fig. 5, if there be made to oscillate electrically and in phase, there will be "interference" of their magnetic fields in the plane of antennæ and addition thereof in the perpendicular median plane. If, however, the oscillations

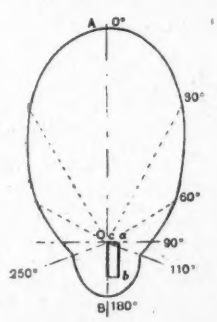


FIG. 4.

FIG. 5.

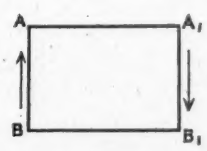


FIG. 6.

are in anti-phase, interference is obtained in the perpendicular median plane and addition in the plane of the antennæ. Such a system would have no effect on a receiving station in the median plane and a maximum effect on one in the plane of the antennæ. This arrangement—first proposed by Brown and later by Blondel (under the name of "champ de concentration")—may legitimately be regarded as a happy application of the principle of Turpain's "interfering fields."

However valuable the system may eventually prove, the excitation of the antennæ, at the required difference of phase, clearly offers practical difficulties.

In order that there may be maximum concentration of Hertzian waves in the plane of the antennæ, the length of the latter should be $\lambda/4$ (λ = wave-length of the oscillations employed) and their distance apart should be $\lambda/2$. At any other distance between the aerials a less sharp concentration of radiation results. A closed vertical rectangular circuit (see fig. 6), in which the current at any given moment is in antiphase in A B, A′ B′, also behaves in the above manner, giving a concentration of field in the plane of the radiating framework.

Bellini and Tosi "*Directive*" *Aerials.*—The special form of aerial, invented by Bellini and Tosi, greatly facilitates the directive emanation and reception of Hertzian waves. Instead of adopting a completely closed rectangular circuit (as in fig. 6), a triangular aerial (fig. 7), almost closed at its apex, is employed. This variation enables considerable simplifications in the system, and the antennæ may now be supported by a single mast. A Braun oscillating circuit induces suitable oscillations in the aerial system through the Tesla transformer S S′ and tuning between the primary and secondary circuits is effected by inductance coils in B C, B′ C′, which also enable a symmetrical adjustment of the two branches.

The variation of the field from a closed rectangular aerial, in different azimuths, follows a sinusoidal law, and the same law naturally expresses the variation of induced E.M.F. in a simple

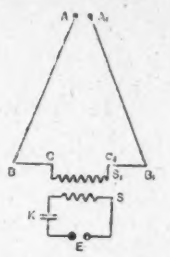


FIG. 7.

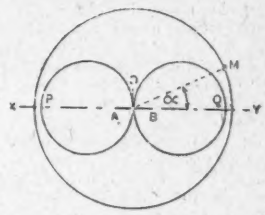


FIG. 8.

vertical aerial placed in various azimuths, but at a constant distance from the sending station. Referring to fig. 8, let A B represent, in plan, the sending aerial, and M the receiving aerial. Then the current induced in M is given by $I = I_0 \cdot \cos \alpha$—*i.e.*, may be represented by a polar vector figure P O Q (two tangent circles, touching at the origin O). It thence follows that the energy

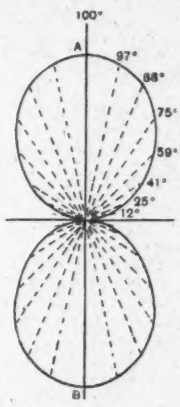


FIG. 9.

received by M (α C) follows the law, $E = I_0^2 \cdot \cos^3 \alpha$, the corresponding polar energy curve being two symmetrical tangent ovals (see fig. 9). Such a diagram was obtained by Bellini and Tosi on measuring—by means of a thermo-galvanometer—the energy received by a vertical aerial situated at a constant distance from one of their triangular directive aerials—the latter being rotated about its vertical axis between readings.

Similarly, if a uniformly radiating transmitting aerial be employed in conjunction with a closed vertical rectangular receiving aerial, the E.M.F. and current induced in the latter will precisely follow the law of fig. 8 and the energy induced, the law of fig. 9 being maximum in each case when the plane of the receiving frame includes the sending station. Whether fig. 8 or fig. 9 represents the actual efficacy of reception in such a system depends on whether the detector employed is operated by the maximum or the total effect received.

Though the employment of closed circuits as "directive aerials" ensures minimum interference among a group of stations thus equipped, there are great practical difficulties in the way of their use. It is seldom that two stations desire only to intercommunicate between themselves, and the large rectangular or triangular aerial frameworks, with sides 50 m. or so in length, cannot easily be swung round to establish communication with other stations. In any case this shape of aerial is very inconvenient.

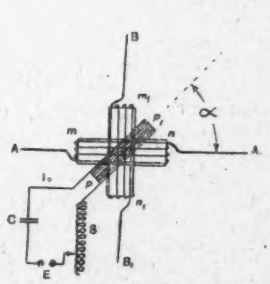


FIG. 10.

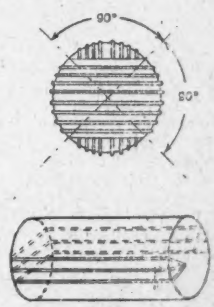


FIG. 11.

The Radio-Goniometer.—By a later arrangement, Bellini and Tosi enabled the emission of variously directed radiations from a fixed aerial.* Two identical aerial frames are arranged per-

* "La Technique Moderne," Vol. II, No. I, p. 1.

pendicularly to each other, as shown in fig. 10; on exciting both simultaneously, a resultant asymmetric radiation of energy is obtained, which has a maximum in a direction dependent on the relative excitation of the two circuits. If the latter be excited according to a sinusoidal law, the excitation of A A′ following the law—I . sin α and that of B B′, the law—I . cos α, the resultant field may be directed to any part of the horizon and is always of constant strength.

The requisite sinusoidal excitation may be obtained as follows:—Two rectangular frameworks—*m n*, *m′ n′*—are inserted in the aerial circuits and are tuned to the same frequency by suitable inductance coils. They form, with the primary *p p′*, a Tesla transformer, the initial osillations being derived from the Braun condenser circuit shown. The primary circuit is syntonic with the tuned aerials and the winding *p p′* may be rotated about the axis of intersection of the planes of *m n*, *m′ n′*. If the exciting coil be relatively very small (the coupling between it and the secondary being then, however, very weak), the aerial currents rigorously follow a sine law and the net radiation is in the plane of the primary coil *p p′*.

To obtain a closer coupling, *i.e.*, a higher coefficient of mutual induction between primary and secondary—it has been found desirable to wind the several bobbins in cylindrical form. The secondary windings consist of a number of turns wound round a hollow bobbin, as in fig. 11, and occupying half the available surface; and an internal primary winding, arranged on a concentric cylinder, which may be rotated about an axis coincident with that of the outer cylinder. By rotating the inner winding, the direction of the emitted radiations may be controlled as above, and, by a similar arrangement, directive reception of signals may be secured.

The radio-goniometer appears likely to be of great value to vessels at sea, and, among the ships already equipped with this apparatus, may be noted the packet steamer *La Provence*. The exact arrangement of aerials on the latter vessel is indicated in fig. 12. Four similar aerials are employed, each being composed of three or four strands (parallel or slightly divergent towards the top). The lower extremities of these aerials are fixed to the corners of a square (whose diagonals make an angle of 45° with the longitudinal plane of the vessel), and are connected to the radio-goniometer by horizontal conductors. A square frame, carried by a span rope between the masts, supports and separates the upper extremities of the aerials. (The latter thus occupy a fixed position with regard to the vessel—though, what this position is, is immaterial.) The two fixed bobbins of the radio-goniometer are each connected to two diagonally opposite aerials and constitute the primary coils of a Tesla transformer, the secondary of which is formed by the inner movable coil connected to the receiving apparatus.

Then, when the vessel receives signals from a station in any particular direction, the fixed primary coils of the radio-goniometer are appropriately excited by their aerials, and the inner coil lies in a resultant field, whose direction is perpendicular to the direction of propagation. Maximum sensitivity of reception is obtained when the movable coil is perpendicular to the field by which it is excited; its direction is then clearly coincident with that from which the signals originate. (More accurate working is obtained by observing the two angular displacements of the movable coil at which the signals just become incapable of detection; the direction bisecting these two extremes is that from which the signals emanate.) In the commercial form of the radio-goniometer, the position of the inner bobbin is indicated by an attached needle moving over a compass card mounted above the windings (the Bellini-Tosi "Compas Azimuthal Hertzien").

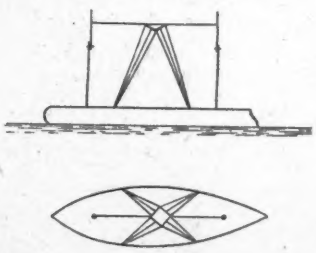


Fig. 12.

The secondary (moving) coil of the apparatus is connected to the detector circuit (fig. 13). The latter resonant circuit comprises the radio-goniometer coil, an invariable condenser C (or two invariable condensers C C′, symmetrically arranged), and a variable condenser C_1. The receiving telephone is shunted across C, and the detector (of the "solid contact" type, a metal point and pyrites crystal) is shunted across C_1. It is, of course, essential that the aerials and the detector circuit be in tune with the signals received, before any attempt is made to localise the latter. Tuning is effected by varying the number of turns employed in the primary coils of the goniometer, and by adjusting the variable condenser C_1.

Practical Tests of the Radio-Goniometer in Navigation.—(1) The land station of Boulogne-sur-Mer was equipped with the above apparatus, and the ironclad *Le Bouvines* having on board an ordinary non-directive radio-system, cruised about 10 miles away in the Channel, giving predetermined signals, from time to time, and simultaneously noting her position. The Boulogne station took the bearing of the vessel at these moments by aid of the radio-goniometer, thus obtaining values which were found to be witnin 2° or 3° of the actual bearings (average results).

2. The ironclad *Le Carnot* was equipped with a radio-goniometer and cruising about 12 miles from the Kerlaer station (Brest), endeavoured to locate the latter. Again, bearings were obtained with an average error of from 2° to 3° and a maximum error of less than 5°.

3. Perfectly analogous results were obtained, over much greater distances, during experiments conducted by the Cie. Générale trans-Atlantique vessel *La Louisiane*.

The above combination of aerials and radio-goniometer, thus constitutes a Hertzian, or radio, compass, enabling as accurate determinations of direction as can be attained (with visible objects) by the use of the magnetic compass.

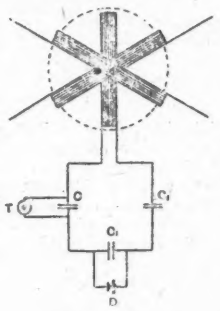


Fig. 13.

Although the partial substitution of submarine bells and microphones for the old siren signals has largely reduced the dangers of navigation in fogs, the radio-goniometer seems likely to be of yet greater value in this respect. Radio-telegraphy is perfectly unimpeded by a foggy atmospheric condition, and, as it is probable that all vessels will be fitted with wireless telegraph apparatus in the near future, the danger of collisions in fog will be practically eliminated. The establishment of coast stations, emitting code signals, similar to those now used by lighthouses, ships, and buoys, will go far to remove the perils of dangerous shores.

NEW ELECTRICAL DEVICES, FITTINGS AND PLANT.

Oil-Electric Set.

The accompanying illustration shows a combined paraffin engine and dynamo set, which has recently been supplied by Mr. J. E. Weyman, of Newcastle, for the North-East Coast branch of the British Arc Welding Co. The dynamo is by Messrs. J. H. Holmes and Co., and the engine by the Parsons Motor Co., Ltd., of Southampton. It is a portable set generating direct current for electric welding, and is used for repairs to castings and rudder posts, but principally for boiler repairs and machine work. In one case a repair was effected within two days, while the estimate by boiler repairers for doing the work in the ordinary way meant a matter of two or three weeks, at a cost of £250.

The weight is kept down as far as consistent with strength in all parts. The bed of cast-steel is well ribbed, and the metal cut down as much as possible. As the set is intended to be used in all sorts of positions, often in the holds of vessels, there would be a difficulty in getting water for the engine circulation; consequently the set

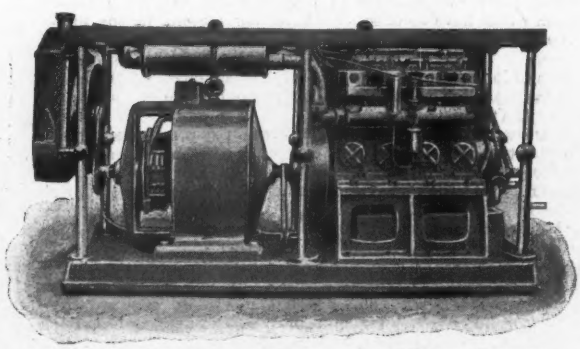


Fig. 1.—28-h.p. Parsons Engine and Holmes Dynamo on Bed-Plate.

is self-contained, with a radiator for cooling the circulation water. As it is all open, the radiator had to be of special construction and size. Strong wrought-iron standards are used, with angle-iron framing, which not only acts as a guard but helps materially in stiffening the bed. In the framework at the top, hooks are formed with permanent slings for lifting purposes. The oil tank is fitted between the standards carrying the engine. As the engine has float feed, a small rotary pump is driven from the dynamo shaft

which pumps the oil up into a small receiver fitted under the frame behind the engine; from this an overflow pipe leads back to the oil tank below. The radiator is carried at the end of the machine on brackets fitted to the standards, the fan being driven by a pulley on an extension of the dynamo shaft. The switchboard, with double-pole switch and shunt regulator on the back of the board, double-pole switch, voltmeter and ammeter on the front, is fixed on the side of the framing and bed behind the dynamo.

B.T.-H. Automatic Motor Control Gear.

As is probably well known, the British Thomson-Houston Co., Ltd., of Rugby, have for many years specialised in switchgear for all purposes, and as a result of their experience the firm are naturally in a unique position to advise and supply switches which embody the requisite features to ensure success in various applications.

Amongst other types, the B.T.-H. Co. have developed in a high degree automatic control gears for various purposes. In the B.T.-H. apparatus, the essential feature is control by current limitation, this method being most satisfactory where a motor has, say, to be started and accelerated or reversed against widely varying loads.

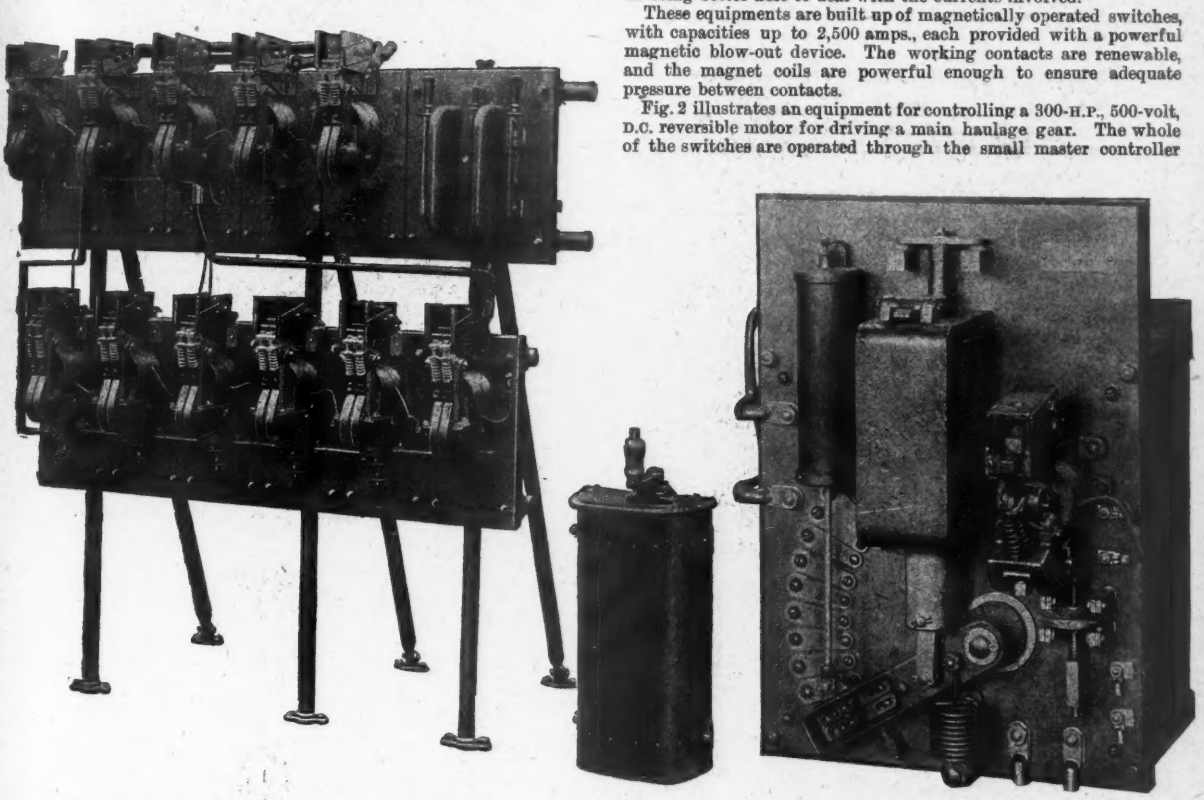


Fig. 2.—B.T.-H. Contactor Equipment, with Master Controller for 300-h.p. Motor.

Fig. 3.—Starting Rheostat, with Time-Limit Control.

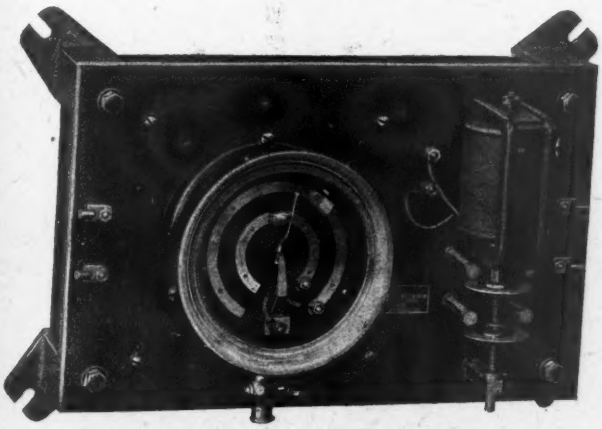


Fig. 4.—Starting Rheostat with Pressure Control.

For motors of small capacity, the above system is more expensive than a time control arrangement, and our illustration, fig. 3, shows a cheap starting rheostat for non-reversing d.c. motors of 15 h.p. or less, with automatic time-limit control. The solenoid and resistances are designed for starting under normal full load at intervals of 4 minutes with a 15-second starting period, which may, however, be regulated by the dashpot.

The motor circuit is opened and closed by a contactor, and the solenoid circuit may be remote controlled by tumbler switches. For motors connected to air compressors, the rheostat is used in conjunction with the pressure governor shown in fig. 4, consisting of a dial-type pressure gauge with adjustable contacts and a small relay for closing the solenoid circuit.

A motor float switch, or a pedal-operated switch, such as is used in capstan work, can equally well be used in conjunction with this (type C R 120) rheostat.

For larger size motors, contactor equipments are recommended as being better able to deal with the currents involved.

These equipments are built up of magnetically operated switches, with capacities up to 2,500 amps., each provided with a powerful magnetic blow-out device. The working contacts are renewable, and the magnet coils are powerful enough to ensure adequate pressure between contacts.

Fig. 2 illustrates an equipment for controlling a 300-h.p., 500-volt, d.c. reversible motor for driving a main haulage gear. The whole of the switches are operated through the small master controller shown on the right, and as the equipment is arranged for current control, slow and careful manipulation of the handle such as would be required with an ordinary drum controller is unnecessary. Such an equipment possesses great durability under adverse conditions, and is such as should be adopted for controlling motor drives for heavy roller trains in rolling mills.

A similar type of apparatus is supplied for use on a.c. circuits, and is largely in use for controlling large induction motor drives for rolling mills, an example of which are the 6,000-h.p. motor drives at the new mills of the U.S. Steel Corporation, at Gary.

Reflectors for Industrial Lighting.

In a new catalogue and price list that is being issued by Messrs. Benjamin Electric, Ltd., of 117, Victoria Street, S.W., there are shown the "Holophane-Benjamin steel line of reflectors" for industrial lighting, which are designed for the lighting of mills, factories, workshops, dockyards and railway stations. They consist of five types of reflectors, four of which are for pendant use, in four different sizes, with lamps of from 17 to 300 watts, while the

Fig. 5.—Holophane-Benjamin Steel Reflector.

fifth type, which is parabolic in three styles, is designed for local lighting, with small lamps, of, say, from 17 to 35 watts. These reflectors are for use with the ordinary shade carrier lampholder, and no gallery is required, or they can be supplied equipped with the "Benco" weatherproof lampholder for outdoor work. They are entirely British made, and are covered by patents and registrations. The illustration shows the Holophane-Benjamin steel reflector, focusing type.

The King's Indian Visit.

In fig. 6 we illustrate the Aster B 7 trolley electric generating set, supplied by the Aster Engineering Co., Ltd., which is being

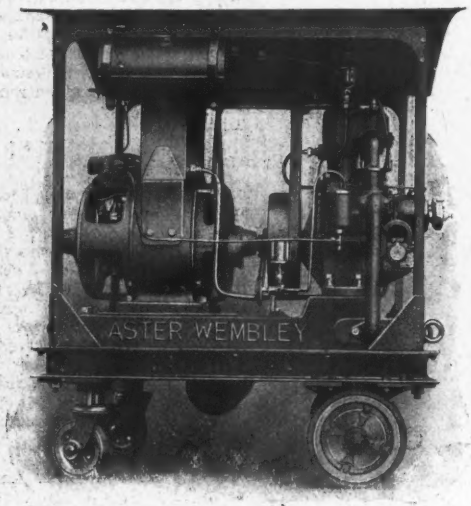


Fig. 6.—Portable Aster Generating Set.

used by the Indian Government for the temporary lighting of the Royal Amphitheatre, used by H.M. the King during his visit to Calcutta.

Petrol Motor and Dynamo.

Side by side with the development of the crude-oil engine for heavy duty, the use of petrol motors for small and medium powers is steadily increasing. This feature is exemplified by the illustration, fig. 7, showing a 25-B.H.P. six-cylinder petrol engine, made by Messrs. J. W. Brooke & Co., Ltd., of Lowestoft, coupled to a "Zone" dynamo, having an output of 17 kw. at 110 to 135 volts, with a speed of 840 R.P.M. The engine is of the four-stroke type, and the equipment includes a rotary cooling-water pump, a throttle

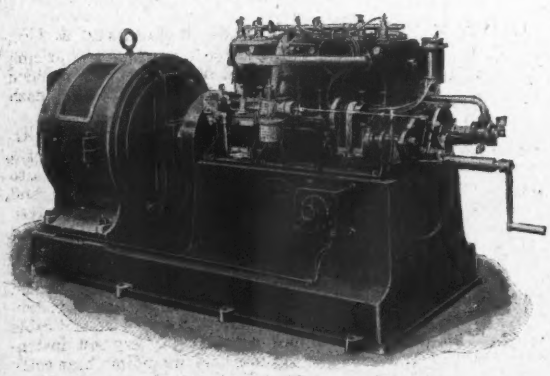


Fig. 7.—Brooke Petrol-Electric Set for Brazil.

governor and a Bosch magneto with an accumulator for dual high-tension ignition. Very great care is taken in the manufacture of these motors, all parts being interchangeable and made to limit gauges, whilst grinding is resorted to for the cylinders, piston rings, gudgeon pins and bushes. The material also is of a very special quality, forged nickel steel being used for the crankshafts and cams, which latter, with their spindles, are cut from the solid bar.

This engine is of Messrs. Brooke's standard marine type, of which thousands are in use all over the world, and as the conditions afloat are more severe than for electric lighting purposes, reliability should be a strong feature. The set in question is for shipment to Brazil.

Simplex "Unit" Fittings.

The Simplex Conduits, Ltd., of Birmingham, have recently introduced a new departure in their fittings business. A system of adjustable parts has been devised to meet the demand which exists amongst contractors in outlying districts and abroad, for some

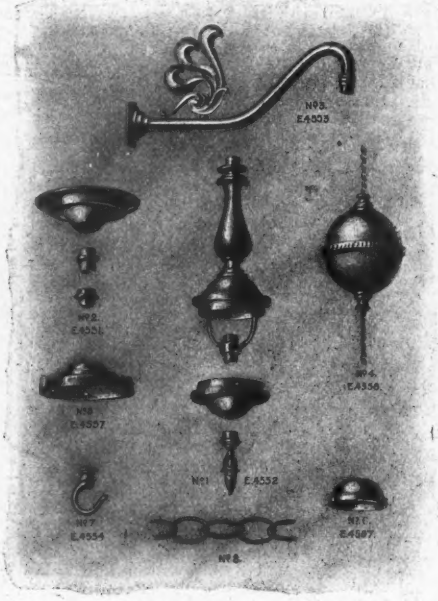


Fig. 8.—Parts of the Simplex "Unit" Fittings.

Fig. 9.—Adjustable Fitting from "Unit" Parts.

Fig. 10.—Ceiling Fixture from "Unit" Parts

arrangement which will enable them to fill orders without delay. The Simplex "unit" system embraces half a dozen parts, as shown in fig. 8, which can be assembled in numerous ways, to produce several different fittings.

It will be noted that the parts include—(1) A stem with cord grip cap; (2) Ceiling plate; (3) Tubular arm with ornament; (4) Spring cord absorber; (5 and 6) Galleries for silk shades and Holophane reflectors; (7 and 8) Hook and chain. These can be assembled in a variety of ways for pendants, brackets, table lamps, &c. Figs. 9 and 10 show a two-light adjustable dressing-table fitting and a ceiling fixture built up from these parts.

LEGAL.

Young *v.* Cleveley's Hydro Co.

George Young, formerly secretary in a South African Mining Co., claimed £100 for alleged personal injuries sustained whilst taking an electric bath from the Cleveley's Hydro Co., Ltd., and the action was resumed at Blackpool on Friday, at the County Court, before his Honour Judge Hamilton. The plaintiff's case was that after spending 15 years in South Africa, he returned to England broken down in health. In June last, on the advice of his medical attendant, he visited Blackpool. At the Cleveley's Hydro he took a radiant heat or electric light bath, during which he complained that his left leg was badly burned, which incapacitated him for some considerable time. His Honour said he knew something about electric burns, as a member of his family was the first person in England to be burned by electric light treatment, and, singularly enough, it was on the same part of the body as in the present case. The recovery took about nine months. Mr. Read, solicitor to the company, intimated to the Judge that the parties had arrived at a settlement, although his clients denied liability, and were not responsible for the burns which plaintiff alleged he had received. They wished to take that opportunity of pointing out that the bath attendant was a skilled man with 10 years' experience in the leading baths in England, but having regard to what the Judge said, his clients felt there might be some moral obligation, and terms had been come to.

His Honour entered judgment for the plaintiff in accordance with the terms of agreement, which were not disclosed.

Ross, Stevenson & Co. *v.* Wright.

An action was raised in the Perth Sheriff Court at the instance of J. Ross, Stevenson & Co., electrical engineers, Edinburgh, against Mr. J. M. Wright, Kinmouth, Bridge of Earn, for delivery of designs for an electric light installation at Kinmouth, and failing delivery for £50, the value put upon the designs by pursuers. It was intimated to Sheriff Sym that the designs had been found at Kinmouth House, and that they had been returned to pursuers. The Sheriff ordained the defender to pay expenses to pursuers on the higher scale.

General Electric Co., Ltd., *v.* Great Western Railway Co.

The Railway and Canal Commission, on Monday, December 11th, composed of Mr. Justice A. T. Lawrence (president), the Hon. A. E. Gathorne Hardy and Sir James Woodhouse, sitting in the King's Bench Division, heard this case on an appeal from the Registrar. Mr. Disturnal and Mr. Tangye were for the plaintiffs, and Mr. Macassie appeared for the appellants, the railway company.

In opening the case for the railway company, Mr. Macassie stated that plaintiffs had brought an application before the Registrar in respect of what they alleged to be undue preference allowed by the railway company to Messrs. Belliss & Morcom, Ltd., in the carriage of electrical machinery from Birmingham, where factories for both firms are situated. Messrs. Belliss & Morcom were manufacturers of engines and agricultural machinery whose goods, being heavy and bulky, were carried under Class 4 of the Railway Rates Act at no prescribed rate, but at a "reasonable sum." The goods of the plaintiff company were carried under Class 4 as machinery in cases with a provision that if the weight exceeded 10 tons an addition of 25 per cent. might be made to the rates. The plaintiffs applied to the Registrar for an order of discovery, alleging that the Great Western Co. was carrying electrical appliances for Belliss & Morcom, Ltd., at the rate of vertical engines, and so giving that firm an undue preference over them. The Registrar, he said, without having a single case presented to him of undue preference, made an order of discovery of three years of the goods carried by the defendant company from Birmingham. He contended that that order was oppressive, and that, in any case, the Court would not allow an order for discovery to be used as a "fishing" order to procure evidence for the plaintiffs without any grounds shown. Moreover, he said he was instructed that Messrs. Belliss & Morcom did not manufacture electrical machinery at all.

Mr. Disturnal, for the plaintiffs in the case, stated that the same application was made by his clients against the L. & N.W. Railway Co., the Midland Railway Co, and the Great Western. The two first-named companies had agreed to supply his clients with 12 typical cases, and he was quite willing to accept an assurance from the Great Western that they would do the same, which would save them from the overhauling of three years' work at Birmingham.

Mr. Macassie declined to give the assurance, and said that if it was true that his clients had been carrying electric machinery at the rate of vertical engines, they had no means of discovering which was which.

Mr. Justice A. D. Lawrence, in giving judgment, said that, in any application of this kind, the ground of the undue preference must be shown, and that had not been done in this case. An order of this kind for a discovery of three years would, he said, be oppressive to the railway companies, and, if it were pursued, would make the conduct of railway business impossible. At the same time, he told the railway companies that the Commission would give every assistance in cases where undue preference was charged, and would put no obstacles in the way of allowing applicants to prove their cases. In this case, however, they thought the order was too wide, and disallowed it, giving plaintiffs 10 days in which to produce six instances upon which their case could be based and their application renewed.

United Lighting Co. *v.* Liescgang.

In this action plaintiffs claimed for breach of contract and for the value of broken electric lamps supplied to the plaintiff company. Mr. Inskip, on behalf of the company, applied to Mr. Justice Coleridge in the King's Bench Division on Saturday, December 9th, for judgment. The defence, said counsel, was struck out in default of discovery, and there was part of the claim, £189 15s., upon which the plaintiff was entitled to judgment at once. The action arose out of a contract for the supply of electric lamps at 1s. 9½d. each, and there was a stipulation that if the breakages exceeded 5 per cent. the defendant should allow the plaintiffs the price of all broken over that limit. The 5 per cent. limit would be 654 lamps, but there were over 2,000 delivered broken. The rest of the action was for damages for breach of contract in the quantity delivered, and in respect of that there would be damages to be assessed by the Official Referee.

His Lordship entered judgment for the £189 15s. and for the amount of damages to be assessed as stated.

BUSINESS NOTES.

Christmas Holidays.—We shall be glad if our friends will take notice of a slight variation in certain of our arrangements for our issue of December 29th. The holidays will this year make no difference in the day of publication, but as our offices will be closed on Monday and Tuesday, December 25th and 26th, the last day for the receipt of "Correspondence" to appear on 29th inst. will be Saturday, December 23rd. Other matters may be sent in by the following Wednesday morning, as usual. Advertisers are advised that new copy and alterations to existing displayed advertisements should reach our offices not later than Friday morning next, December 22nd.

Catalogues and Lists.—Messrs. Baxendale & Co., Ltd., Miller Street, Manchester.—Catalogue illustrating and pricing all kinds of Christmas, New Year and other presents, included among them being electric fires and radiators and pocket flash lamps.

The British L.M. Ericsson Manufacturing Co., Ltd., 82-85, Fleet Street, London, E.C.—Two sections have been issued of a new catalogue, and others are to follow. Special binders are also being prepared in two sizes, one to take three sections only, and the other for the complete set when ready. We have received sections "M" and "S," which can now be obtained by interested members of the trade who have not yet received them. Section "M" contains neatly tabulated prices and beautifully executed half-tone illustrations of portable instruments, including combined telegraph and telephone instruments, portable telephone instruments, portable switchboards for metallic circuits, wire and cable reels, contact rods, micro-telephones, cells, and battery test instruments. Section "S" is devoted to protectors, including heat coils, fuses, serrated protectors, discharge coils, terminal boxes, apparatus on porcelain bases, junction-boxes, carbon protectors, protectors with carbons, fuses and heat coils mounted in wooden boxes with glass cover or on special frames. We have nothing but praise for the excellent style in which this catalogue is being issued.

Messrs. Falk, Stadelmann & Co., Ltd., 83-87, Farringdon Road, London, E.C.—New catalogue (No. 239) containing 234 pages of illustrations, prices, code words, and brief particulars of a whole host of electrical fixtures. These include, first, a variety of brackets ranging from the plain and simple to the beautifully shaded fitting of choice design, including those of various periods, Dutch candle fittings, and iron brackets; ceiling fittings also progress through a range from simplicity to ornateness, and in corridor and hall pendants and iron lanterns there are designs to please almost every conceivable taste. This remark applies equally well to the very impressive collection of electroliers, adjustable pendants, and silk shade pendants, which occupies many pages. Fittings for indirect lighting, portable and adjustable standards, floor standards, statuettes, some charming fancy figure suspensions, church fittings,

wireless multiple light fittings follow, and after them comes a collection of cardboard, silk, glass, bead and other shades, also "Aureola" luminous radiators, out-door lanterns, brackets, signs, and Efesca lamps. It may be thought that we have named a list of ordinary lines, and could have compressed all that we have said into a couple of sentences, but the catalogue is no ordinary one of its kind, and we are afraid that our words will hardly convey a correct idea of how full and complete is the collection of fixtures here shown, some of which are to us quite new. We have no doubt that the book will be required by most electrical contractors and traders.

Messrs. W. T. Henley's Telegraph Works Co., Ltd., Blomfield Street, London Wall, London, E.C.—Pamphlet containing a reprint of an article on the power and telephone equipment of the Llanharran Colliery, which was carried out by the firm.

Messrs. Pritchetts & Gold, Ltd., 58, Victoria Street, London, S.W.—Leaflet containing an illustrated description of the Pritchett "B1" accumulators which they are supplying both at home and abroad for working large bell, telephone, and signalling systems in country houses, hotels, factories, mines, and the like. The cells can be charged either like ignition accumulators or from lighting circuits by means of the firm's charging switch. Contractors are invited to apply for the list.

Messrs. S. J. Howland & Co., 110, Cannon Street, London, E.C.—Leaflet giving particulars of the "Oro" metallic-filament lamps and a list of prices for lamps ranging from 20-30 to 200-260 volts, and in candle-powers from 8 to 1,000. A small table of comparative costs of the "Oro" and carbon lamps in current consumption per 1,000 hours is given.

Messrs. Siemens Bros. Dynamo Works, Ltd., Caxton House, London, S.W.—We have received a copy of the firm's new lantern-slide list. This, we understand, has been revised and considerably increased by the addition of many interesting and up-to-date slides. The set now consists of 180 different views, and they are kept in stock at Caxton House in readiness for lending, free of charge, to lecturers, schools, &c.

The Diesel Engine Co., Ltd., 179, Queen Victoria Street, London, E.C.—Two publications; one a pamphlet giving information regarding the Diesel engine, its economy with figures as to costs, and a list of plants installed abroad, the other containing a number of half-tone views of various sizes of the engines for electrical and other service, up to 1,000 B.H.P. size. The pictures include views of electrical plants at Vera Cruz, Bombay, Calcutta, and several home stations for electric light and power, tramway, cotton mill and other works. Copies of these pamphlets can be obtained on application.

Endolithic Manufacturing Co, Ltd., Pomona Buildings, Fore Street, London, E.C.—Leaflet showing a number of designs of labels in ivory, bone, brass, &c., for affixing to electrical apparatus, machinery, &c.

The Detroit Engine Works, 77, Gamage Building, Holborn, London, E.C.—Circular containing a description, illustrated, also a list of prices of the Detroit portable stationary oil engines for small electric light plants. Sizes ranging from 2 to 20-B.H.P. are included.

The Dowsing Radiant Heat Co, Ltd., 105, Great Portland Street, London, W.—Leaflet illustrating and stating prices of some new designs in the shape of "Redglow" radiators (Bastian heaters).

Canadian Enterprise in Spain.—A fresh instance of Canadian enterprise through Belgian and French circles is represented by the announcement made from Brussels that the Pearson group has in preparation an issue of bonds of the Barcelona Traction, Light and Power Co., which is to be made in Paris and Brussels. The question was also referred to at a meeting of the Electric Light and Power Investment Co. held in Berlin, on December 7th, when the chairman stated that the Compania Barcelonesa de Electricidad, in which the former is largely interested, is confronted with the prospect of competition, although negotiations are proceeding with the object of arriving at an understanding. Since then the Compania Barcelonesa has issued a notice intimating that Canadian promoters have acquired large water powers in the Pyrenees, and raised capital in America and Europe for the purpose of utilising the power for the electrical transmission of energy to Barcelona, it being intended to largely underbid the present company in prices. Although it would have remained to be seen how far this proposal would have been carried out by the Barcelona Traction, Light and Power Co., which has been formed in Toronto, there is no doubt that the Compania Barcelonesa would have been faced with severe competition and probably a decline in prosperity. These considerations induced the directors of the latter company not to refuse to negotiate in regard to the offer of purchase made by the Canadian promoters, who have proposed a price for the shares at the rate of 140 per cent. The negotiations have not yet been concluded, although a decision is expected at the end of the year. The Compania Barcelonesa, it should be explained, is substantially a German undertaking, which was formed in 1895 by the A.E.G., the Deutsche Bank, the Bank for Electrical Enterprises of Zurich and other financial institutions. After paying dividends of 7½ per cent. for five years in succession, the distribution was raised to 8 per cent. in 1910, and a similar rate is expected for the present year.

Annual Dinner.—The annual dinner of Messrs. T. W. Vaughan & Co., Ltd., of Islington, N., took place last Saturday evening, at the Builders' Arms, Lynton Street, N., Mr. Vaughan taking the chair, and Mr. Tappenden, foreman of the Art Metal Works, acting as vice-chairman. The chairman referred to the large increase in the staff and business generally during the year. A number of visitors were present, also the following heads of departments: Mr. A. J. Mister, electrical department; Mr. A. W. Crapper, brass finishers' department; Mr. T. Tappenden, ironwork department; Mr. J. Cook, heating and gas department; Mr. Dickinson and Mr. Morris representing the office; Mr. Jordan, outside representative. Toasts were given and responded to, and the musical honours were given by Messrs. Good, Nutting, Strudwick and Bolding.

Electro-Galvanising Plant.—An electro-galvanising plant for coating boiler tubes and special fittings is being erected in accordance with Mr. Sherard Cowper-Coles's designs and specifications for the Las Sociedad Espanola de Construccion Naval, Ferrol, Spain, which company is entrusted with the building of the new Spanish Navy.

Liquidation.—Automatic Trolley Head Co., Ltd.—A meeting is called for January 23rd, at 82, Victoria Street, London, S.W., to hear an account of the winding up from the liquidator, Mr. H. S. Foster.

Bankruptcy Proceedings.—Oswald Carr, Oak Works, Headingley, and 31, Estcourt Terrace, Headingley, Leeds, York, electrical engineer.—The public examination of this debtor took place last Tuesday at the County Court House, Albion Place, Leeds, on accounts showing a deficiency of £59. It transpired that the debtor started business in 1890. Last September a meeting of his creditors was held when an offer of 5s. in the £ was made, and declined. The debtor's turnover during the past three years had averaged £1,000 a year, leaving a net profit of between £150 and £200. His present position had been brought about by bad debts. Debtor stated that all his assets had been sold to his father for £150, and the business registered as a limited company, he being the manager, and holding one share. The issued capital was £90, of which his (debtor's) wife held £77. The causes of his failure were want of capital, bad debts, and losses on contracts. An adjournment was ordered.

A. P. Parker, electrical engineer, of May Street, Burnley.—At the Burnley Bankruptcy Court, on December 7th, this bankrupt appeared to undergo his first public examination. Debtor formerly carried on business in Yorkshire Street, and he attributed his position to "sickness of myself and family, and loss on contracts." The liabilities were £174, and the deficiency amounted to £139. Debtor commenced business in October, 1910, without capital. Previously he had been a journeyman electrician, earning an average wage of £1 per week. There had been no profit from the concern. The examination was adjourned.

Thomas Topping, electrical and mechanical engineer, Southport.—Receiving order made at Liverpool on December 8th, on debtor's own petition.

Book Notices.—"Hazell's Annual for 1912." London: Hazell, Watson & Viney, Ltd. Price 3s. 6d. net.

"The Rubber Industry." By Dr. Joseph Torrey and A. Staines Manders. 1911. London: The International Rubber and Allied Trades Exhibition, Ltd. Price 15s. 6d. net.

"Science Abstracts." Sections A and B. Vol. XIV, Part 2. November 25th, 1911. London: E. & F. N. Spon, Ltd. Price 1s. 6d. net each.

"How to do Business by Letter and Advertising." By Sherwin Cody. 1911. London: Constable & Co. Price 5s net.

"The Induction Motor." By B. F. Bailey. 1911. London: Hill Publishing Co., Ltd. Price 10s 6d. net.

"*Journal* of the Western Society of Engineers." Vol. XVI, No. 8. October, 1911. Chicago: The Society. Price 50 c.

Trade Announcements.—Consequent upon increased business and the necessity for holding larger stocks, the Hart Manufacturing Co. have taken over premises next door to their existing address, doubling their former accommodation. Their address is now 76 and 77, Rochester Row, Westminster, S.W.

Mr. T. A. Nunwick has now commenced business on his own account as manufacturers' agent, and has opened offices and stores at Ayton Buildings, King Street West, Manchester. He will represent the Wandsworth Electrical Manufacturing Co., Ltd., and the Standard Cable Manufacturing Co., Ltd., in Lancashire, Yorkshire, and Cheshire; the Light Alloy Co., and Oliver Arc Lamps, Ltd., in Lancashire and Cheshire; and the Hart Accumulator Co., Ltd., in Lancashire only.

Messrs. Herbert G. Richardson & Co., of Walsall, have, owing to increase of business, moved into larger premises, and have acquired the mill on the "Old Wharf." They can now give quicker deliveries of their standard lines in switchgear, magnetic separators, electric cranes and haulage gears, and have put down a plant for the production of turned work for the trade in brass and steel. Their address after to-day will be Magnet Works, Wolverhampton Street, Walsall; Telephone No. 400, Walsall.

Messrs. J. Hopkinson & Co., Ltd., announce that their works will close for the holidays on Saturday noon, December 23rd, and will resume on Thursday morning, December 28th.

Catalogues Wanted.—The Wolseley Sheep Shearing Machine Co., Ltd., of Sydney Works, Alma Street, Aston, Birmingham, want catalogues in duplicate from makers of material, instruments, and apparatus necessary for installations for electrically lighting country houses, and the general equipment of electrical plants for agricultural purposes at home and abroad.

Belgium.—Works for the manufacture of electric motors are about to be established at Liége by La Société de la Fabrique Belge d'Outillage.

"Tantalum."—MESSRS. SIEMENS BROS. DYNAMO WORKS, LTD., announce that in future all tantalum lamps supplied from their works and stores at Tyssen Street, Dalston, will be marked on the bulb with the word "Tantalum," and in a short time all deliveries of these lamps from their branches will bear the same mark.

"Zed" Fuses and "The Miracle."—MESSRS. SIEMENS BROS. DYNAMO WORKS, LTD., inform us that they have received the order to supply the whole of the fuse distribution boxes and iron-clad switch and fuse gear required in connection with the forthcoming production at Olympia of the wordless play entitled, "The Miracle." The "Zed" distribution boards will, of course, have to comply with the Theatre Regulations of the L.C.C., and the supply of these boards in record time (the order has to be completed in 10 days) was only made possible by the firm's extensive experience of theatre installations, enabling them to standardise boards of suitable design. The whole of the iron-clad switches will be of their standard "S W" type manufactured at Stafford works. The firm has been obliged to adopt special arrangements to keep pace with the demand for these fuse boxes.

LIGHTING and POWER NOTES.

Accrington.—The T.C. has confirmed the scheme for the substitution of gas for steam in the generation of electricity. The estimated cost is about £27,000. It is hoped by this means to cheapen the price of current and to solve the difficulty of extensions. The present electricity works are being run to the fullest capacity, and with the contemplated supply of current to Haslingden, Clayton-le-Moors, and Church, considerably more generating plant will be required. To extend the steam power system would necessitate a new site on a large scale and the duplication of buildings, plant and staff. For the present it is intended to install a complete unit of 2,000 B.H.P. of power gas plant, with by-product recovery, arranged in such a way that additional units can be installed to the ultimate extent of five, or a total of 10,000 B.H.P. It is estimated that for a 60 per cent. load factor on 2,000 B.H.P. there is a saving in favour of gas of £1,100 per annum, allowing 12½ per cent. for interest and repairs, and taking coal at 10s. per ton. It is also estimated that a further sum of £1,250 per year will be forthcoming from by-products. Tenders have been received and the L.G.B. is being asked to grant borrowing powers.

Mr. John Newton, employed by Messrs. Howard & Bullough, has gained some distinction by the erection of six working class cottages in Pilot Street, Accrington, which will contain no gas pipes at all. As an experiment—the first of its kind in the district—nothing but electricity will be provided for lighting and all other purposes.

Ascot.—For some months the original electrical plant laid down by the Ascot District Gas and Electricity Co., four years ago, has been inadequate. Now, by the installation of a Mirrlees-Diesel oil engine of 150 H.P. working a 100-KW. generator, the plant capacity has been practically doubled.

Ashburton.—The U.D.C. has decided to oppose the application of Messrs. Purves, of Exeter, for a prov. order for E.L.

Barking.—The U.D.C. has decided to support the Bill of the I.M.E.A., and to contribute up to £7 10s. towards the cost.

Blackpool.—The T.C. dealt with several interesting matters at the meeting on December 7th. The electrical engineer was authorised to lay a new H.T. lighting feeder and a new tramway feeder from the electrical works to the western end of Chapel Street, where a new transformer kiosk is to be erected. Mr. Furness and a deputation of councillors have visited several towns for the purpose of inspecting electrical machinery with a view to recommending the most approved type for the contemplated extension of the electricity works.

Bridlington.—The T.C. has revised the tariff for current for general lighting to 4d. per unit for exceeding 750 units per quarter, and up to 1,000, and to 3½d. per unit for over 1,000 units, up to 1,500.

Burton-on-Trent.—The electrical engineer (Mr. Thos. Hall) has submitted a report upon the extension of the electricity works, at a total estimated expenditure of £17,150. He stated that he proposed to replace the No. 1 generator with a three-phase machine of the turbine class, which would be capable of generating 1,250 KW. on full load, as against 80 KW. of the No. 1 generator. The Council would then have two systems of generating, and as it would take some time to complete the change over, it would be necessary to give a supply on both systems for some time to come, and for a considerable time to supply the outlying districts, principally for lighting purposes, from the single-phase mains. To obtain the advantages due to the turbine, he proposed putting in a motor-generator from three-phase to one-phase, which could be run inverted to give either three-phase or one-phase supply. The tramways would be supplied in the same manner from the turbine, by means of a second motor-generator. With regard to switchboards, he proposed erecting a new switchboard on a gallery. The steaming capacity of the boilers in the boiler house was quite sufficient as long as the turbine condensers were working efficiently, but to provide against an emergency, a water-tube boiler should be erected. The economisers, main flues and main stack being too small, it would be necessary for economical working to have new economisers and a new stack of larger dimensions. The proposed boiler would allow the Council to take a maximum load equivalent to that of the turbine, after which it would have to extend the boiler house. Dealing with mains, the engineer stated that those in the central part of the towns were already overloaded and would have to be duplicated. They also required extending from the works to the Shobnall Road district. It was proposed to put down a new H.T. three-phase main, and at first to connect on to this the largest power consumers. Any further applications would then be dealt with on this system, and as the mains in the centre of the town required renewing, this could be done from year to year until the whole system was converted to three-phase. New offices and stores would be required owing to the new plant occupying the space now taken up by them. The approximate expenditure the engineer puts as follows: One 1,250-KW. turbo-alternator and condenser, £4,750; foundations, £400; pipework, £200; one 500-KW. motor-generator (three-phase to one-phase), £1,200; one 300-KW. motor-generator (three-phase to D.C.), £800; foundations and connections, £200; one switchboard and gallery, £600; one water-tube boiler and pipework, £1,800; six superheaters for old boilers, £800; new stack and economisers and extension to main flue, £2,500; new H.T. main and alteration to existing motors, £2,400; new offices and stores, £600; alteration to existing screens, &c., £500; contingencies, £400. In conclusion, the engineer expressed the desire to proceed at once with the erection of the superheaters, to get the benefit of the economy in working; also, if possible, one of the motor-generators and the mains in readiness for any new motors in the coming summer. The Electricity Committee, after considering these proposals, recommended that they be approved, and application is to made to the L.G.B. to the borrowing of the £17,150 for executing the work. The work of extending mains to Shobnall Road is to be proceeded with at an estimated cost of £528, and the work of converting 19 gas lamps into electrical lamps is also to be carried out. Mains are also to be extended from Station Bridge to Moor Street at an estimated cost of £150.

Canterbury.—The T.C. has decided not to support the Bill of the I.M.E.A. In Committee it had been decided to support the Association, and to contribute up to £10 towards the cost. The Council considered it inadvisable to state the reasons for the withdrawal of the suggested support.

The Council has decided to jointly oppose the Bill of the National Electric Construction Co., Ltd., confirming free wiring agreements with several Corporations, including Canterbury.

As the result of an opposing petition on the part of the T.C., the Kent Electric Power Co. has cut out Canterbury from its area, and the city is now an island in the centre of the area of the company.

Chile.—Don Carlos Alberto Gohannsen has obtained a concession for providing the Town of Coquimbo with electric light; and a similar concession has been granted to Don Ignacio Fernández for an electric light installation in the Town of Calama. In each case 12 months are allowed for the carrying out of the work. The Department of the Interior has approved the project for the installation of an electric lighting and power plant at Bulnes.—*Board of Trade Journal.*

Continental Notes.—GERMANY.—The recent death of Dr. Kallmann, electrical engineer to the Municipal Council of Berlin, has brought forward not only the question of a successor, but also that of the municipal purchase of the undertaking of the Berlin Electricity Works Co., which has a monopoly of supply in the German capital. According to the agreement between the city and the company, the former is empowered, but is not under the obligation, to acquire the company's works, rights, patents and patent rights on October 1st, 1915. The purchase price is to be on the basis of the book value or a valuation, at the option of the city. The existing renewal fund is not to be considered in fixing the price, but will devolve upon the city. Two years at the least before October 1st, 1915, the city has to inform the company if it is intended to exercise the right of acquisition. If notice is not given the agreement will automatically continue for a further period of three years. If the undertaking is purchased after the date in question, the book or valuation price, excepting for sites and buildings, will become reduced by 10 per cent. for each period of three years after October 1st, 1915. A Berlin newspaper, in discussing the situation of affairs, states that it is scarcely to be doubted that the city will make use of its rights in 1915. Although the agreement with the Grand Berlin Tramways Co. was recently prolonged for 20 to 30 years, special difficulties were in the way of carrying out a transfer, but these were removed by way of compromise. Similar obstacles do not stand in the way of the taking over of the Berlin Electricity Works, and it is, therefore, thought probable that the right of municipalisation will be exercised.

The Essen electricity works is installing an 18,000-KW. Zoelly turbine coupled to a Siemens-Schuckert generator, speed 1,000 R.P.M. Two 6,000-KW. steam turbines by the same makers, Escher-Wyss, are at present in use at this station.

BELGIUM.—La Société des Charbonnages de la Haye has decided to establish electricity generating plants at its collieries at Tilleur and Saint-Nicolas-lez-Liége.

NORWAY.—The Kykkelsrud Electrical Works, which for years have been the greatest factor in electric supply to Christiania, are now about to largely extend their field of operations. The transmission pressure will be increased from 20,000 volts to 50,000, by means of which alteration the works will be enabled to supply the surrounding districts in a more effective manner with power and

light. The new transmission plant will be completed in the spring.

The new municipal electrical works at Bergen are expected to be completed at the end of March, 1912, and the large generators are now under installation. The consumers are waiting with great impatience, having in the meantime to console themselves with the prospect of a reduction of the price—viz., from 4d. to 3½d. per unit.

Dartford.—The U.D.C. has decided to support the Bill of the I.M.E.A.

Darwen.—It is proposed to run a new cotton mill at Highfield by electricity, and the Electricity Committee has been asked for its terms for supplying energy.

Dublin.—At the last meeting of the South Dublin Union a discussion took place with reference to a dispute with the contractors for the electric lighting of the Workhouse. Mr. Nicholl, secretary to the Electrical Trades Union, wrote stating that the contractors for the electric lighting were employing non-union workmen, contrary to the terms of the advertisement inviting tenders for the contract. Mr. Crimmins moved that the letter be sent to the manager of the A.E.G. Electrical Co., the contractors, for his explanation with reference to the matter complained of. Mr. Lawler moved, as an amendment, that the contract be carried out in accordance with the agreement and conditions specified, and that, in carrying it out, union labour only be employed. The amendment was carried, on a division, by 24 votes to 3. Mr. Crimmins said, in fair play to the contractors, they should be supplied with a copy of the letter. The contractors did good work, and they should receive fair treatment. A letter was subsequently read from a solicitor, on behalf of the contractors, making the following proposal: "To take opinion of an independent electrical engineer accustomed to the inspection of this class of work, whose appointment should be mutually agreeable, as to whether the work has been carried out in accordance with the specification, and the alterations made by order of the engineer during construction, and if he decided that the work has not been so performed, my clients will pay his fees, which might, perhaps, be from 15 to 30 guineas; and if he should decide to the contrary, the Guardians are to pay the fees and to pass a resolution acknowledging that the work has been done satisfactorily." Mr. Ganly suggested that the reports of their engineer and clerk of works showed that the proposal should be accepted. The chairman said that these reports showed that the work was being carried out properly and satisfactorily—in a high-class manner, and the best material was being used. He accordingly suggested that they should wait, without taking further action, until the work was completed, and they could get a report from the engineer, and decide what course should be taken. He moved that as an amendment, and it was adopted.

Dundee.—An action has been raised against the Corporation, at the instance of a local electrical engineer, craving to interdict it from continuing the sale of lamps to consumers. It is alleged that the Corporation electricity department has no authority to trade in this way, and that its action is injurious to the business of the local engineers.

East Ham.—It has been decided to amend the existing scale of charges for the supply of current for power so as to provide that when the total consumption exceeds 1,000 units per quarter, the charge should be 1½d. per unit, as against 2d. per unit for not exceeding 150 units per quarter under the existing scale. It has further been decided to supply and maintain, on hire, high candle-power flame arc lamps at inclusive rates from £6 10s. per annum.

Eton.—Speaking at the last meeting of the Board of Guardians, one of the members (Mr. Howlett) spoke of the difference in the cost of the electric supply and the cost of gas during the half-year. He said the cost of lighting the infirmary with electricity and supplying electric power for pumping water and the laundry was £79 6s. 3d., whereas the cost of gas for one stove and lighting, including mantles and burners, during the same period was £163 7s. 8d., the cost of gas being about twice as much as electric light.

Farnham.—At a meeting of the Council, the Public Works Committee reported having considered the application by the Farnham Gas and Electricity Co. for the Council's consent to the supply of electric current by means of cables affixed to the fronts of houses, and recommended the Council to inform the company that it was not prepared to give a general consent for the whole of the district, but would be prepared to consider special cases, as they might from time to time arise. The recommendation was adopted.

Farnworth.—Owing to the extravagant use of electricity in houses supplied on the fixed sum of 6d. per week, the U.D.C. has decided to increase the charge for the winter to 9d. per week. If there is a decrease in the energy used, the price will probably be reduced again. It was reported that the price received per unit had not amounted to more than 2d.

Gillingham (Kent).—The T.C. has decided to include in the extension of the offices, stores and workshops at the electricity works, provision for a showroom.

The Bill of the I.M.E.A. is to be supported, and up to £10 contributed towards the costs.

Greenock.—Port-Glasgow power users (shipyards and engineering works) are stated to have indicated their willingness to meet the conditions laid down by the Greenock Corporation for the supply of electricity. Arrangements will accordingly be made at an early date to carry out extensions which will involve the town in an additional capital outlay for plant of about £25,000. One of the conditions laid down was that Port-Glasgow power users should guarantee to take a minimum amount sufficient to pay interest and sinking fund charges on the capital employed on the extension. The negotiations, which now promise to have such a pleasant ending, have been protracted.

Guildford.—The T.C. has appointed a Committee to consider the advisability of having the E.L. installed in the Council Chamber.

Hereford.—The T.C. has adopted the telephone system of charging for current for lighting, heating and other domestic purposes, doing away with the need for a separate heating circuit and meter. The charges are a flat-rate of 7s. per lamp, in general use, of 50 watts per annum, and in addition 1½d. per unit, less 5 per cent. discount. The flat-rate of 7s. per lamp is to be paid in advance.

Herne Bay.—A report is to be prepared for the U.D.C. on a scheme for carrying out the electric lighting order submitted by the Pier electrical engineer.

Heston and Isleworth.—Application is to be made to the L.G.B. for sanction to borrow the following amounts: £1,200 for mains, £800 for house services, and £5,000 for the provision of additional machinery and plant at the generating station. At the meeting of the Council a letter was read from the Heston-Hounslow Ratepayers' Association deprecating the expenditure of the £5,000, and an amendment was moved to postpone the application for a month. In answer to a question, Mr. Gentry said that the Committee could go on with its present provision for 750 KW., if it could be sure of immunity from accident. Extra plant was certain to be wanted in October next, and it would take quite six months to get sanction to the loan and another six before the machinery could be obtained. In the result the amendment was negatived.

Higham Ferrers.—The T.C. has decided to invite the local authorities interested to discuss the E.L. scheme being promoted by Messrs. J. Thornton, Brooke Sampson and J. Clark for Rushden, Higham Ferrers, Irthlingborough, part of the area of the Wellingborough R.D.C., and Chelveston. The promoters are to be invited to meet the Council and to discuss the scheme.

Keighley.—The Electricity Committee of the T.C. has decided to apply to the L.G.B. for a loan of £6,576 for electricity purposes, viz., mains and services, direct current, £2,000; services, alternating current, £600; coal-handling plant and foundations, £536; water tower, piping and excavation, £1,100; economiser, additional tubes, £150; motors on hire, £600; motor-generator, £550; over expenditure, £840; contingencies, £200.

Killeshandra.—At the last meeting of the Rural Council, a letter was read from the L.G.B. with reference to the recent inquiry held into the application of the Cavan R.D.C. to be invested with the powers of an urban authority for the purpose of having the town lighted by electricity. The Board stated that, although there was some opposition to the scheme, if the Council desired to proceed with it, the L.G.B. would give sanction and directions for the issue of the necessary order. After discussion, the Council decided to at once apply for the necessary order, the area of charge to be Portaliffe.

Linlithgow.—At a meeting of the T.C. a letter was read from the agents for the promoters of a scheme of electric lighting which it is proposed to introduce in an area embracing certain districts of Linlithgowshire and Stirlingshire. Explanations having been given as to why the promoters had scheduled only a part of the burgh of Linlithgow, in the meantime the Council agreed to consider the whole proposal at an early date.

Liverpool.—The Tramways and Electricity Committee at its meeting on December 8th, adopted a resolution to take into consideration the question of cheapening the charge for electric current, and the electrical engineer has been instructed to draw up a report on the subject. It is stated in some quarters that the cost of electricity in Liverpool, as compared with other centres, is such that it militates against the increased use of energy for industrial power purposes.

London.—A conference of representatives of the Borough Councils of Poplar, Stepney, Hackney, Shoreditch and Bethnal Green is to be convened for the purpose of formulating a definite policy of linking up the electricity undertakings of the eastern area of London.

HAMMERSMITH.—The Electricity Committee recommends, and advertisements are to be issued inviting offers for the disposal of a quantity of disused plant, which has accumulated from time to time, and certain materials, such as arc lamps, globes, &c., the use of which has been dispensed with owing to the recent change from arc to metal-filament lamps for street lighting. The original cost of the superheater, condensers and economiser included in the list was £2,232, on which there is a balance of £1,485 loan outstanding. The Committee says that it may be necessary to consider later the question of repaying this outstanding balance of loan, toward which the sum realised on the proposed sale would go. In no case where there is a balance of loan outstanding will the plant have to be replaced.

Marylebone.—A flat rate of 1½d. per unit is to be given as an alternative cooking tariff to the maximum demand rate of 2d. and 1d. for consumers on the telephone system of charge, owing to the difficulty experienced by manufacturers' canvassers in attempting to introduce cooking apparatus without being able to inform consumers precisely what rate they were going to pay for current consumed.

Hammersmith.—The Electricity Committee has approved a scheme for supplying, fixing and maintaining flame arc lamps on hire to consumers, with wiring and fittings necessary, at the following annual rentals, including the charge for current supplied:—(*a*) Minimum hours of lighting, 500 per annum; (*b*) hire per pair of arc lamps per annum, £11; (*c*) hire of single arc lamp, £6 10s.; (*a*) 600 hours per annum; (*b*) £12; (*c*) £7; (*a*) 700 hours per annum; (*b*) £13; (*c*) £7 10s.; (*a*) 800 hours per annum; (*b*) £14; (*c*) £8. The rate per hour over the minimum period per pair, the rate per hour over the minimum period per single lamp, and the additional extra charge for wiring where necessary, is put at 3d., 1½d, and £1 respectively in each case.

Hackney.—Owing to the Hackney Wick network becoming considerably overloaded, distributing mains are to be laid to strengthen it at an estimated cost of £900. The Electricity Committee reports that it has been advised by the electrical engineer that the safe load which the generating machinery at the works was capable of sustaining had been reached, and that it would be necessary to take immediate steps in order to supplement the existing plant. The Committee had had under consideration details and estimates of a scheme prepared by the engineer for dealing with the future demands, but before reporting on the matter to the Council it desired to take independent expert opinion, and an engineer is to be selected to report at a fee of 50 guineas.

Stepney.—The Finance Committee has received a reference from the Electricity Supply Committee to the effect that it was desirable that steps should be taken with a view to the provision of a motor converter, switchgear, and new feeder with a view to meeting the increasing demand for current, and asking the Committee to recommend the Council that it should be empowered to take the necessary steps for the provision of the machinery, and the carrying out of the work, and that application be made to the L.C.C. for sanction to the borrowing of a loan of £10,000, the cost of the work, £5,500 of which is for converters, switchboards, and foundations, and £4,500 for feeder cables. The Finance Committee has agreed.

At a recent Joint Conference of London electric supply authorities representing the following boroughs—Battersea, Fulham, Hammersmith, Hampstead, Islington, Poplar, St. Marylebone, Shoreditch and Stepney, and the Charing Cross, Chelsea, City of London, County of London, Metropolitan, and South Metropolitan Companies—the Chairman gave a forecast of the future programme, especially with regard to the important question of linking up the supply undertakings of London under the powers conferred by the London Electric Supply Act, 1908.

Lytham.—Mr. P. J. S. Tiddeman visited Lytham last week to interview the local Traders' Association, on behalf of the Lytham Electric Lighting Co., and spoke of the importance of electricity to Lytham. He said that an initial outlay of £10,000 was necessary before they could proceed with the scheme. Up to the present they could count on £4,000; if the subscription of capital was favourable the works could be ready by May next, and he believed the investment would be a sound one in every respect. At the Lytham Council meeting on December 7th, the clerk admitted that negotiations were proceeding.

Middleton.—With a view to supplying electricity to a fairly large number of prospective customers in Middleton Junction, the Electricity Committee has decided to lay a cable to the district.

Newport (Mon.).—The T.C. is applying for power to supply current to houses at Christchurch, which is outside the borough.

Newton-le-Willows.—The U.D.C. has decided to apply to the B. of T. for a prov. order for E.L. with power to transfer it, and with powers for the Council to purchase, deal in, and fix motors and other apparatus and fittings.

Penmaenmawr.—The U.D.C. has decided to apply to the L.G.B. for sanction to borrow a further £196 for the purpose of additional lighting of the promenade, this sum being the expenditure incurred over and above what was contemplated in the original application for £550.

Perth.—At its next meeting the County Council is to be asked by the Finance Committee to pass a resolution opposing the application which is to be made to the Secretary for Scotland for a provisional order to incorporate a company for the purpose of providing a hydro-electrical generating station at Loch Ericht. It is proposed to use the water of the loch river, and to distribute electrical energy for all purposes in the county of Perth. The Finance Committee states that until the order itself is lodged, it will not be possible to judge exactly the effect of the proposals as affecting the county, and the Committee thinks it advisable that the matter should be kept open so that the order may be opposed should this be found necessary.

Pettigo.—A movement is at present on foot here to have the town lighted by electricity. Various experts have been consulted, and there seems to be a general consensus of opinion that the power obtainable from the local river would be insufficient in summer. Under the circumstances, it will probably be necessary to install an engine of about 20 H.P., and this will cost approximately £400.

Pontefract.—The Electrical Distribution of Yorkshire, Ltd., has decided to withdraw its application for a prov. order for the borough.

Queensbury.—The U.D.C. has appointed a deputation to discuss with the Bradford City electrical engineer the terms for a supply of electricity for the district.

Redditch.—The U.D.C. has decided that application be made to the L.G.B. for sanction to borrow a further £341 for electric lighting purposes, in addition to the sum of £5,850 already applied for, making a total of £6,191, for extensions in connection with the undertaking.

Sheffield.—The general manager of the electricity department is to submit a list of thoroughfares which he is prepared to light experimentally with electricity.

South Africa.—The electric light plant of the Greytown Local Board is being removed to a more suitable site near the railway station, where siding accommodation will be arranged for the delivery of coals. A 360-ampere-hour Tudor battery with booster is being added which will make the supply of current available through the 24 hours.

Stockport.—The T.C. has fixed a special rate for current for arcs for photographic purposes. Subject to the payment of a meter rent of 5s. per quarter, current will be supplied at a flat rate of ¼d. per unit, except during November, December, January and February, when the charge will be 3½d. per unit for current consumed between 4 p.m. and 10 p.m.

Stoke-on-Trent.—The T.C. has decided to give a trial with electric cookers for hiring out, and some of these are to be obtained at a cost of not exceeding £50.

Stroud.—A complete electric plant for power and lighting is being installed by Messrs. Apperly, Curtis & Co., Ltd., at Dudbridge Mills.

Taunton.—The Council has just obtained a 200-K.V.A. alternator from Messrs. Crompton & Co. Arrangements are being made with the Great Western Railway Co. for a supply of current to be used for track signalling. This is the first introduction of electric supply in the extensive stations and yards at Taunton.

Teignmouth.—Dr. J. A. Purves, of Exeter, has informed the U.D.C. that as the Council does not see its way to agree to his proposals, he does not feel disposed to prosecute his application for a prov. order for electric light.

Tonbridge.—The U.D.C. has adopted a bonus scheme for the employés at the electricity works by which a sum equal to 10 per cent. of the net profit each year will be distributed, the bonus not to exceed three weeks' pay.

Topsham (Exeter).—Damage to the extent of £2,000 which is covered by insurance, was done on Sunday night by fire to the Topsham electricity works, which, with the exception of the accumulator room, were destroyed. It is thought that the outbreak was occasioned by the ignition of the roof of the building by a spark. As a result of the destruction of the works, the town was in darkness.

Torquay.—At the last meeting of the Torquay T.C., a recommendation of the Electricity Committee was approved to the effect that it should be allowed to incur a cost not exceeding £75 in preparing plans for the erection of a new generating station, it being understood that such authority should not carry with it the approval of the Council to the erection thereof. Mr. Langdon, chairman of the Committee, said that they could not go beyond 18 months or two years under the present conditions, and it was absolutely necessary that the matter should be taken seriously in hand.

Tottenham.—At the last meeting of the Education Committee it was decided to wire one of the new schools for electric lighting in the event of favourable terms being received from the North Metropolitan Electric Light Co.

Tunbridge Wells.—The T.C. has decided not to support in any way the I.M.E.A. Bill to give local authorities power to wire consumers' premises, and to supply fittings, &c. The Lighting Committee recommended the Council not to support the proposal.

Turton.—A L.G.B. inquiry was held on December 6th into the application of the U.D.C. for a loan of £4,500 for electricity purposes. There was no opposition. The Council purchases its current from the Lancashire Electric Power Co., and it is intended to light Bradshaw Road, where there is no gas supply, by means of overhead wires.

Wakefield.—The city electrical engineer having prepared a scheme for the supply of electricity to the Sandal and Belle Vue districts, a sub-committee has been deputed to confer with the Street Lighting Committee as to the public lighting of Sandal.

Wardle (near Rochdale).—The U.D.C. is in correspondence with the B. of T. with respect to the supply of electricity within the district.

West Ham.—The Electric Lighting and Tramways Committee reports that in May last the Council decided to apply for a loan of £59,000 for extensions to plant, &c., at the generating

station. Since then, however, the demand on the generating station has considerably increased, and as a result, after having given careful consideration to reports supplied by the electrical engineer, it is of opinion that in lieu of £59,000, £87,825 should be borrowed, made up as follows: River service pipe and strainer, £9,950; buildings, £19,000; engine room plant, £14,520; boiler house plant, £28,240; coal plant, £7,400; contingencies, £1,640; general mains, £6,000, &c.

Westhampnett.—A prov. order for E.L. in the area of the R.D.C. is being applied for by the Bognor Gas Co.

Wimbledon.—The Electric Lighting Committee has appointed a sub-committee to consider the desirability of the Council entering into an arrangement with the Fixed Price Light Co., Ltd., for the supply of energy to private houses for lighting purposes at a fixed price per annum. A specification is to be prepared by Mr. Jas. Swinburne and the superintendent of the Fire Brigade for the installation of a new fire alarm system in the borough, and a copy is to be forwarded to Siemens Bros. and Co., Ltd., and the Gamewell Fire Alarm and Police Telegraphs, inviting them to submit revised tenders in accordance therewith. A charge of 2¾d. per unit is to be made for energy supplied to existing consumers for the purpose of Christmas decorations, provided their premises are wholly lighted by current supplied by the Corporation.

TRAMWAY and RAILWAY NOTES.

Australia.—According to the *Standard*, it is understood that Mr. Merz, who has been engaged by the Victorian Government in connection with the scheme for the electrification of the suburban railway lines, will shortly call for tenders for the carrying out of the proposals. A railway official, who has had much experience in connection with the Victorian railways, will proceed to London at an early date to assist in the formulation of the scheme.

Birmingham.—A meeting of the ratepayers of the city, convened under the Consolidation Act, has approved of the proposed Corporation Tramway Bill.

Continental.—Austria.—It is reported that an American syndicate is in negotiation with the Austrian and Hungarian Governments with reference to the construction of an electric railway between Vienna and Budapest.

Portugal.—A serious and unusual tramway accident occurred at Oporto on Sunday last, when two tramway-cars, after being derailed, ran down a steep hill into the river. Fourteen bodies were subsequently recovered, but many more are feared to have perished in the river. The injured number 37. Feeling against the tramway company is reported to be very high.

Germany.—The Bavarian Traffic Ministry has placed the order for the whole of the transmission equipment of the Garmisch-Partenkirch-Landesgrenze electric main line now building, with the Bergmann Co. The working pressure for this railway will be 15,000 volts, and in the transmission pressure 50,000 volts.—*E.T.Z.*

It is proposed to convert the suburban light railways in the vicinity of Darmstadt to electric traction, and to extend the network of electric tramways under a scheme of co-operation between private enterprise and the Municipal Council. For this purpose the city authorities and the South German Railway Co. intend to form a new company with a share capital of £200,000 and bond capital of £250,000, and 50 per cent. of the share capital will be issued to the city, 1 per cent. to the provincial authorities and 49 per cent. to the company. Five representatives of the city will be on the board of directors, five of the present company and one for the province, and the period of the concession is to be 30 years.

Sweden.—The Swedish railway authorities have now taken the first decisive step toward the future, involving the electrifying of all the Swedish railways. The electrification of two different suburban lines between Stockholm-Märsta and Gothenburg-Alingsaas has now been decided on. The total capital expenditure for both lines is estimated at nearly £200,000, and the Government has been asked to put forward a proposition to the Riksdag next year for the granting of the necessary money. According to the estimate, £100,000 will be wanted for transmission cables and transformer stations, while £88,000 is required for the purchase of rolling stock and materials. As, however, the present rolling stock can be utilised elsewhere, the expenditure will be of a nominal character.

Halesowen.—At the meeting of the R.D.C. on Wednesday last week, the clerk submitted lengthy correspondence with respect to the Halesowen Light Railways Extension Order, 1911, as provisionally settled by the Commissioners. It included a letter from the Commissioners to Mr. Kennedy of November 8th, drawing attention to the limitation of purchasing powers of the Halesowen District Council under the Draft Order with regard to the line in Quainton, and refusing to alter the provision in the Order that the railways may be commenced within 12 months from the date. A further letter has since been received from the Railway Commissioners, stating that the amendments made to the Draft Order as regarded the purchase of the original railway were purely consequential on the change of boundary of the Halesowen Council since the Transfer Order of 1909 was made by the Commissioners, and that such amendments would not seem to affect the District Council prejudicially, having regard to the present boundary of the district. It was also stated that representations might be made to the Commissioners. It was decided to instruct the clerk to write to the Commissioners, and to strongly press them to reinstate the Council in the Halesowen Order to the same position that it held with regard to purchase under the Transfer Order of 1909.

Leeds.—Since the settlement of the Leeds tramway strike in July last, when, with the assistance of Sir George Askwith, of the B. of T., an agreement was drawn up and assented to by the Corporation and the tramwaymen, there has been growing dissatisfaction among the men, who allege that the terms of the agreement have been contravened by the Corporation in certain particulars. They complain that the average hours per week are below 54, that no payment is allowed for meal times on duties under hours, that the "spread over" duties have increased in number and that the previous notice of the shed staffs and day labourers has not in all cases been considered as a qualification for increased pay. Protracted negotiations have failed to effect a settlement of the men's alleged grievances, and it was resolved that an appeal should be made to Sir George Askwith to act as arbitrator on the points in dispute, in accordance with the July agreement. On Friday last a Leeds deputation met Sir George Askwith at the Chief Commissioner's Rooms in Whitehall, and placed its views before him. The Corporation were represented by Alderman Brown, Alderman Tetley and Alderman Kinder, and Mr. J. B. Hamilton (tramways manager), and the men's case was presented by Alderman G. T. Jackson (Amalgamated Association of Tramway and Vehicle Workers), Mr. G. H. Pearson (Secretary of the Leeds branch) and two employés. The conference lasted some time, and all the points having been fully discussed, it was arranged that Mr. Hamilton should meet Mr. Pearson in Leeds on Monday and discuss the accuracy of certain figures regarding wages which were presented by Mr Pearson. The result of those deliberations will be communicated to Sir Geo. Askwith, who will give his decision in due course.

London.—Hammersmith.—A letter has been received from the solicitor of the L.C.C. stating, in connection with the arbitration proceedings for the sale of the London United Tramways Company's undertaking within the County of London to the County Council, that the £1,000 deposited by the company with the B.C., as security for the completion and maintenance of the tramways, had been included in the claim, and asking whether, as the tramways were now about to pass to the L.C.C., the B.C. would agree to repay to the company the sum in question, as if that is repayed the company would withdraw the amount from the claim. The Law and Parliamentary Committee has decided to inform the solicitor of the L.C.C. that, notwithstanding the change of ownership, it does not see its way to agree to the proposal.

The recent report of the London Traffic Branch of the B. of T., refers to the proposals of the G.P.O. Committee as to the carriage of mails in London by electric railway. A 7½-ft. deep-level tube containing two 2-ft. gauge tracks, and running in the first instance 6½ miles—between Whitechapel, the G.P.O., and Paddington—is proposed, which would accommodate motor-wagons capable of a maximum speed of some 35 miles an hour. The cost is estimated at about half a million, and considerable extensions linking up the chief offices in the north, north-west, west, and south-west, and principal railway termini, are suggested, if the first section of the scheme proves satisfactory.

Middlesex.—The Light Railways and Tramways Committee of the County Council has decided to support the Metropolitan Electric Tramways, Ltd., in the promotion of a Bill in the ensuing session of Parliament for the purpose of obtaining powers for the construction of an independent line of tramways from Finsbury Park terminus to the Manor House, subject to the County Council having the option of taking over the powers of the company in connection with the construction of the line. The local authorities affected are to be asked to support the scheme.

Morecambe.—On the Heysham tramways, which are worked by the Morecambe Tramways Co., petrol-driven motor tramcars, supplied by the Leyland Motors, Ltd., Preston, are being substituted for horse traction.

Newcastle-upon-Tyne.—The Corporation has decided, on the recommendation of the Tramways Committee, to purchase four motor-omnibuses for use in the city and between the city and North Walbottle.

New Zealand.—The Nelson B.C. has appointed a special committee to prepare, with the city engineer, a report on the question of tramways for the borough. The Palmerston North B.C. has decided to obtain a report from Mr. F. Black, electrical engineer, Wellington, as to the installation at Palmerston of an Edison battery or overhead trolley tramway.

Oldham.—At the meeting of the T.C. last week, Alderman Wild asked whether tramway rails to be put down in West Street came from Germany or America, or whether they were made in England?—Councillor Dunderley said he had examined some of the rails, and found they had been made in Germany.—Councillor Middleton, chairman of the Tramways Committee, replied that the specifications issued to the contractor provided that the rails should be of British manufacture. He gave the order to an English firm on the understanding that the rails would be made in England. The firm appeared to be agents for a German firm, and as soon as the contractor found out that the rails had been made in Germany, he told the borough surveyor

in a straightforward manner what had taken place.—At a further special meeting the matter was again discussed, and eventually the contractor agreed to sacrifice any extra profit he might obtain in view of being allowed to go on with the work, which it was agreed should proceed.

Paisley.—Considerable damage has recently been done to cars of the District Tramway Co., and Mr. Coutts, the general manager, intimates that the service on a certain route during workers' meal hours may have to be withdrawn. Last week a double-decked car was so smashed in the upper deck that it will cost £20 to £30 to repair it.

Rotherham.—At a meeting of the T.C. a lengthy discussion took place on the proposal of the Tramways Committee to extend the Dalton tramway to the proposed terminus at Thrybergh. Councillor Thompson moved that the resolution accepted by the Council in October be rescinded, urging that they ought to investigate the circumstances before they committed themselves to an expenditure of £10,000. The motion was seconded and supported, one member expressing the view that the matter should be deferred until it was seen how far railless cars might be successful. The Tramways Committee's proposal to construct the tramway was confirmed by a large majority.

South Africa.—The Bloemfontein Town Council has, with three dissentients, adopted the recommendation of the city engineer for the railless trolley system, and has referred the matter to the Finance Committee to make arrangements for the necessary loan.

The Johannesburg tramway receipts for the past four months amount to £107,246, being an increase of £10,950 on the corresponding period of last year; while the passengers carried totalled 9,350,000, which is an increase of over 1½ millions on the corresponding period.

Stockport.—The T.C. has unanimously decided to promote a Bill authorising it to run railless cars from Mersey Square to Marple. The estimated cost of the scheme is £12,000.

Wigan.—Mr. Jas. Slevin, tramways engineer and manager, states that since the installation of car meters, at a cost of £250, there has been a saving in energy consumption of 10·86 per cent.

Wolverhampton.—The Corporation Tramways Committee has decided to fit up six tramcars with top-deck covers at an estimated cost of £600, which amount is to be met out of the tramways reserve fund.

The T.C. has received from the L.G.B. sanction to a loan of £10,400 for electricity purposes.

TELEGRAPH and TELEPHONE NOTES.

All-Night Shopping by Telephone.—A number of large firms in London have made arrangements for receiving orders for goods by telephone at all hours of the night, the articles required being dispatched by the first delivery in the morning.

Australia.—The Government proposes to spend in 1911-12 on the wireless telegraph stations at Pennant Hills and Fremantle, £16,800, and on telegraphs and telephones, £1,300,000.

On Friday last the Postmaster-General, referring to the protracted dispute that had taken place between the parties concerned in wireless telegraph systems, announced that the Government had decided to erect immediately wireless stations round Australia, adopting a system invented by the Government wireless expert.

Austria.—The Austrian Ministry of Finance has given approval to an appropriation of £833,000 for the extension of the telephone system.

Cheap Telegrams.—In answer to a question in Parliament, the Postmaster-General stated that the rate for non-urgent plain-language telegrams to Australia, to be introduced on and from January 1st next, would be 1s. 6d. a word. These telegrams would be accepted on condition that they might, if necessary, be delayed for 24 hours.

Hythe.—The T.C. has agreed to a suggestion made by the National Telephone Co., that the action brought by the company against the Council shall be stayed on the condition that each party pays its own costs.

Monument of the Telegraphic Union.—The *Journal Télégraphique* of November 25th reproduces an illustration of the design adopted for the international memorial of the foundation of the Telegraphic Union, with the detailed description furnished by the artist, Giuseppe Romagnoli.

Overhead Wires.—A deputation representing 16 Metropolitan Borough Councils was received by the Postmaster-General recently, in connection with the erection of overhead wires for telephone service. In his reply, Mr. Samuel pointed out that the action of the Post Office in treating telephone wires as telegraph wires was undoubtedly legal, and in case of dispute, the decision had been almost invariably in favour of the Post Office. At present the mileage of the Post Office wires in the metropolitan area was 1,090, of which 671 miles were underground, 330 miles overhead on private property, and only 50 miles overhead along the roads. The cost of underground wires was five to ten times as much as that of overhead wires, and if the former were adopted, the charges to subscribers must be increased. If they wanted cheap telephones, they must not insist on underground wires. After the transfer of the National Telephone Co.'s system, large numbers of overhead lines would be placed underground. Negotiations were in progress with the Association of District Councils of Middlesex, which, he hoped, would lead to an agreement by which wayleaves would be granted quickly and the question whether overhead or underground wires should be adopted would be settled by definite rules. He suggested that steps should be taken to draw up a similar agreement for the Metropolitan Borough Councils' areas.

Russia.—The State has just secured the right of acquiring the city telephone system in St. Petersburg. A committee, composed of representatives of the Ministries of Finance and Home Affairs and of the St. Petersburg Municipal Council, will settle the terms of purchase. It is said that the Administration of Posts and Telegraphs will in the near future approach the problem of the nationalisation of municipal and private telephone systems, and it is concluded from this circumstance that the intention to entrust certain interurban telephone schemes to private companies has been abandoned.

A Bill has been presented to the Duma by the Russian Minister for Home Affairs providing a credit of about £950,000 to be applied in the construction of new telegraph lines, and for the connection of existing systems.—*Board of Trade Journal.*

Telegraphists' Cramp.—A Departmental Committee which has considered the problem of "telegraphists' cramp" has issued its report. The trouble is not attributed to any single cause, and there is no royal road to a remedy. The suggestions include careful selection of workers, with particular attention to candidates who show signs suggesting permanent nervous weakness, to stiff wrists, heavy, clumsy hands, and inability to write easily. Ambidexterity, it is also recommended, should be encouraged; young telegraphists should not be employed at first on heavy and difficult circuits, nor should the seniors be kept exclusively on the heavier Morse instrument. Periodical relief from the Morse instrument is suggested, and the Committee discusses the newer inventions which are replacing the Morse apparatus; the latter, however, hold the field for the time being. Importance is attached to the use of seats of suitable height.

Telegraphists' Grievances.—As the result of agitation on the part of the Postal Telegraph clerks, the Postmaster-General has agreed to appoint a committee of inquiry in 1913.

The Telephone Transfer.—The Postmaster-General has brought in a Bill to amend the Telephone Transfer Act, 1911, so as to authorise the Government to make a payment to the National Telephone Co. of a sum on account of the telephone purchase money before the total sum payable is finally ascertained. On Wednesday it passed through Committee without amendment.

A Telephonic Farce.—This title is not, as might be supposed, an allusion to our telephonic service in this country, but to a one-act farce entitled "Tuppence, please," which is being produced at the Royalty Theatre, London, as a curtain-raiser. It is a satire on the call-box telephone service provided at a large London hotel, and of course embodies all the customary annoyances with which we are all familiar, as well as a number of additional sources of irritation. It appears to be quite amusing.

Wireless Telegraphy.—In order to maintain communication with the Mawson expedition to the Antarctic regions, arrangements are being made for the erection of an intermediate wireless station on Macquarie Island, 600 miles south of Hobart.

A Commission appointed by the Joint Wireless Board at Iloilo, in the Philippines, has recommended the erection of an extended system of wireless telegraphy in the islands. It is proposed to set up 13 chief stations, beginning with the Batan Island in the north and reaching to Jole in the south. The erection of 14 intervening stations is also proposed. The cost of the undertaking is estimated at $300,000.—*Elek. & Maschinenbau.*

The new Marconi station at Teneriffe was opened the day after the new stations at Cadiz, Barcelona, and Las Palmas.

A wireless station has been erected on the roof of the Ministry of War at Vienna. The structures supporting the antennæ are two lattice-work towers each 65 metres high.

CONTRACTS OPEN and CLOSED.

OPEN.

Australia.—N.S.W. Government Railways.—January 8th, 1912.—Four 1,000-kw. rotary converter units. January 22nd, 1912.—Supply and erection at the White Bay power house, Sydney, of eight water-tube boilers, with superheaters, economisers and mechanical stokers. January 29th, 1912.—A 25-kw. booster set. Particulars, Electrical Engineer's Office, 61, Hunter Street, Sydney.

January 9th, 1912.—Accumulators, booster, switchboard and accessories, for the Subiaco Council. Town Clerk's office. Deposit of £100.

Croydon.—December 22nd. The B.C. invites tenders for 2,000-volt and 5,000-volt switchboards, and erection of the same complete (estimate £4,000). See "Official Notices" December 1st.

Dartford.—January 23rd. One high-speed vertical uniflow engine, tandem generators and three-wire balancer, three superheaters and extensions to pipework, switchboard and electrically-driven centrifugal pump, for the U.D.C. See "Official Notices" to-day.

France.—January 5th, 1912. The French Post and Telegraph authorities in Paris are inviting tenders for a multiple telephone board for the Central Telephone Exchange.

Grimsby.—December 18th. Fine slack coal for the T.C. electricity works, for a year. W. A. Vignoles, electrical engineer.

Hornsey.—January 11th. One steam dynamo set (either reciprocating or turbine), for the T.C. See "Official Notices" December 8th.

London.—L.C.C.—The Main Drainage Committee is inviting tenders from six selected firms for the installation of electric light in the new engine-house at the Abbey Mills pumping station. The Highways Committee contemplates an expenditure of £4,000 on the renewal of the electrical installation in Blackwall Tunnel in 1912-13.

HAMMERSMITH.—It is recommended that the Council invite tenders for the supply of flame arc lamps in quantities of not less than 50 in one year, in connection with the proposed hiring-out scheme.

New Zealand.—March 7th, 1912. Napier Corporation. (1) Permanent way, overhead work and supply mains; (2) power station, car-shed and repair-shop equipments; (3) rolling stock. Deposit 2½ per cent. Specifications can be seen at the Board of Trade Commercial Intelligence Branch in London.

Sheffield.—December 21st. Two sets of 25-KW. high-speed direct-coupled vertical engines and alternators, for the City Council. See "Official Notices" December 8th.

Siam.—December 30th. Tenders are invited for five electrically-driven centrifugal pumps for the waterworks at Bangkok. Particulars, Local Sanitary Department, Bangkok.

BANGKOK.—March 15th, 1912. Tenders are invited for the supply and erection of an electric power station with a capacity of 3,000 KW. Tenders, on the prescribed forms, to the Ministry of Local Government, Bangkok. For further particulars see this column for November 24th.

Swansea.—January 6th. Water-tube boilers, superheaters and mechanical stokers, for the Corporation Electricity Department. See "Official Notices" to-day.

CLOSED.

Bexley Heath.—The U.D.C. has ordered for its car-sheds "Bennis" stokers and self-cleaning compressed-air furnaces from Messrs. Ed. Bennis & Co., Ltd., Little Hulton, Bolton.

Bury.—The following tenders for supply of electrical plant have been accepted by the Corporation:—

Phœnix Dynamo Manfg. Co., Ltd.—Two battery boosters combined with a motor.
A. Reyrolle & Co., Ltd.—Switchgear.
W. T. Glover & Co., Ltd.—High-tension trunk mains.
British Westinghouse Electric and Manfg. Co., Ltd.—Two 750-KW. rotating transformers.

Dewsbury.—The Electricity and Tramways Committee has decided to order a spare armature for the steam turbine at the electricity works from the British Westinghouse Co., Ltd., at the price of £285.

Rotherham.—The T.C. has accepted the following tenders:—

Steel, Peech & Tozer.—Tramway rails.
Hadfields.—Crossings and points.
Bayliss, Jones & Bayliss.—T.e-bars.

Sheffield.—The City Council has accepted the tender of Halley's Industrial Motors, Ltd., at £730, for the supply of a four-cylinder 40-H.P. motor tower-wagon for the tramways department.

London.—POPLAR.—The B.C. has received the following tenders for the supply of three motor-driven centrifugal circulating water pumps with a capacity of 4,800 gallons per minute, required in connection with the extensions at the generating station:—

Gwynnes, Ltd.	£1,620
Rees Roturbo Co.	1,655
Worthington Pump Co.	2,002

The calculated maximum head submitted is 35 ft., 39 ft. and 48 ft. respectively, and the B.H.P. of the motors is 67, 90 and 110, with a maximum efficiency of 76, 80 and 81 per cent., and a minimum efficiency of 60½, 75 and 70 per cent. respectively. After considering the tenders, the Electricity Committee decided to accept that submitted by the Rees Roturbo Co., Ltd., for three 16-in. Roturbo pumps with 16-in. suction and delivery valves and pipes.

HAMMERSMITH.—The Electricity Committee received the following tenders for cables:—

Standard Cable Manufacturing Co., Ltd.	(recommended)	£277
General Electric Co., Ltd.		292
Connolly Bros., Ltd.		315
Union Cable Co., Ltd.		316
Western Electric Co., Ltd.		322
Electrical Engineering and Agency Co., Ltd.		328
Aubert, Grenier & Co.		328
Siemens Bros. & Co., Ltd.		347
Callender's Cable and Construction Co., Ltd.		348
British Insulated and Helsby Cables, Ltd.		348
Johnson & Phillips, Ltd.		348
W. T. Henley's Telegraph Works Co., Ltd.		352
Reginald Todd		354
Pirelli, Ltd.		360
W. T. Glover & Co., Ltd.		363
Craigpark Electric Cable Co., Ltd.		370
Drake & Gorham, Ltd.		393

The tenders for steel and ironwork, required in the construction of the platform around the new turbo-alternator, were as follows, the erection to be carried out by the department:—

Aston & Co.	(recommended)	£144
Cadogan Ironworks Co.		144
J. Wilson & Co.		159
Measures Bros., Ltd.		160
Dorman, Long & Co.		174
Young & Co.		196

L.C.C.—The Stores and Contracts Committee has recommended tenders from the following firms for stores for the year 1912:—

Electric insulating materials.—L. Andrew & Co.
Electric cables and wires.—Hooper's Telegraph and India-Rubber Works, Ltd.; Yorkshire Cable Co., Ltd.
Electric lamps.—A.E.G. Electric Co. (foreign); Brimsdown Lamp Works, Ltd. (British); Brush Electrical Engineering Co., Ltd. (foreign); General Electric Co., Ltd. (British).

In its reference to the lamp tenders the Committee made the following observations:—"As regards electric lamps, we considered it desirable to obtain alternative tenders for lamps of British or foreign make. In the case of the carbon-filament lamps, we recommend acceptance of a tender for foreign-made lamps, the result of recent tests of the lamps offered having proved satisfactory. The prices are about 21 per cent. less than those quoted in the lowest tender for British-made lamps, and about 20 per cent. below the prices at present paid under contract for British lamps. In the case of the metal-filament lamps, we advise the acceptance of lamps of British make, passing over tenders for foreign lamps not of equal efficiency. As regards traction lamps, experiments are being conducted, and we consider it desirable, therefore, to accept a tender for only one-half of the estimated quality. For this a tender for foreign-made lamps is recommended, the lowest tender for British lamps being 20 per cent. higher."

South Africa.—POTCHEFSTROOM.—Our Durban correspondent writes:—"In one of your contemporaries dated October 13th, 1911, it is reported that the Potchefstroom Town Council has accepted the tenders of Messrs. Reunert & Lenz and Hubert Davies and Co. for supplying and erecting plant for the Council's electricity works, the total of the two tenders being £12,487. The lowest tender (by Messrs. Siemens) for the whole of the work is reported to have been £12,243. This report is incorrect, as the whole of the order has been placed with Messrs. Siemens, and the work is being proceeded with at present in the shops of Messrs. Siemens Bros. Dynamo Works, Ltd., and Messrs. Siemens Bros. & Co. The order includes two generating sets with booster, battery and switch plant for the power station, and an extended overhead distributing system at twice 240 volts D.C. The plant is expected to be ready for putting into service in March 1912."

Stretford.—The U.D.C. has accepted the tender of the Union Cable Co., Ltd., at £2,407, for the supply of ·8 traction cable, pillars and link-boxes.

West Ham.—The tender of Mr. J. T. Halsey has been accepted by the Education Committee, at £499 18s. 6d., for the installation of electric light at the Gainsborough Road School. The tender of Messrs. Cammell, Laird & Co., Ltd., has been accepted by the T.C. for a supply of tramcar steel tires, at £1 6s. 9d. per tire, less 2½ per cent.

Wimbledon.—The tender of the Western Electric Co., Ltd., has been accepted by the T.C., at £67, for 1,200 yards of telephone cable with telephones, bells, &c.

Worksop.—The U.D.C. has placed with Messrs. E. Bennis and Co., Ltd., a contract for stokers and self-cleaning compressed-air furnaces for the electricity works.

BRAZIL: ITS PRESENT CONDITIONS AND THE POSSIBILITIES FOR FUTURE COMMERCIAL RELATIONS WITH GREAT BRITAIN.

By C. E. BEST and H. L. PARROTT.

(*Continued from page* 883.)

The Rio de Janeiro Tramway, Light and Power Co.—We will now proceed to give our readers a brief description of the undertaking of this important Canadian company, which was established in 1904 in the capital.

The company was incorporated in Toronto, under the laws of Canada, in June, 1904, to acquire and operate valuable concessions and privileges granted by the Governments of the Brazilian Republic and of the State of Rio de Janeiro, and by the Council of the City of Rio de Janeiro, to carry on an electrical business in the Federal District and in the City and State of Rio de Janeiro, and to acquire two great water-powers, construct and install the necessary hydraulic electric plants, to generate and supply electric current for purposes of traction, light and power.

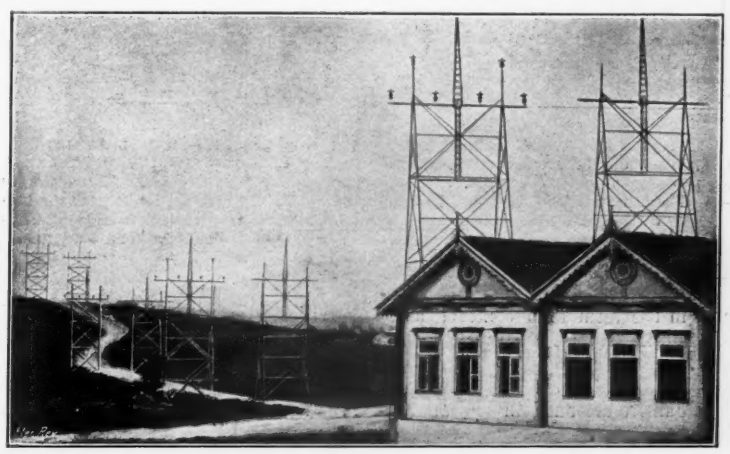


FIG. 1.—VIEW OF TRANSMISSION LINE BETWEEN RIO DAS LAGES AND RIO DE JANEIRO, SHOWING STYLE OF TOWERS.

Each line carries two 3-phase circuits. The porcelain insulators measure 17″ diameter across the top and are tested to 120,000 volts.

The water-powers are situated:—(1) On the Rio das Lages, 56 miles from Rio de Janeiro; (2) at Sapucaia on the Rio Parahyba, about 100 miles from Rio de Janeiro.

After a careful examination, it was decided to develop the former water-power first, and hold the latter in reserve, as it was believed that the Rio das Lages was only capable of developing 40,000 H.P., whilst the Sapucaia power can easily develop 100,000 H.P. in the driest season.

When the construction was commenced, the clearing of the banks of the Rio das Lages disclosed that the reservoir formed by the dam which the company built had a much larger capacity than was anticipated, and consequently a much greater power can be developed. By another concession

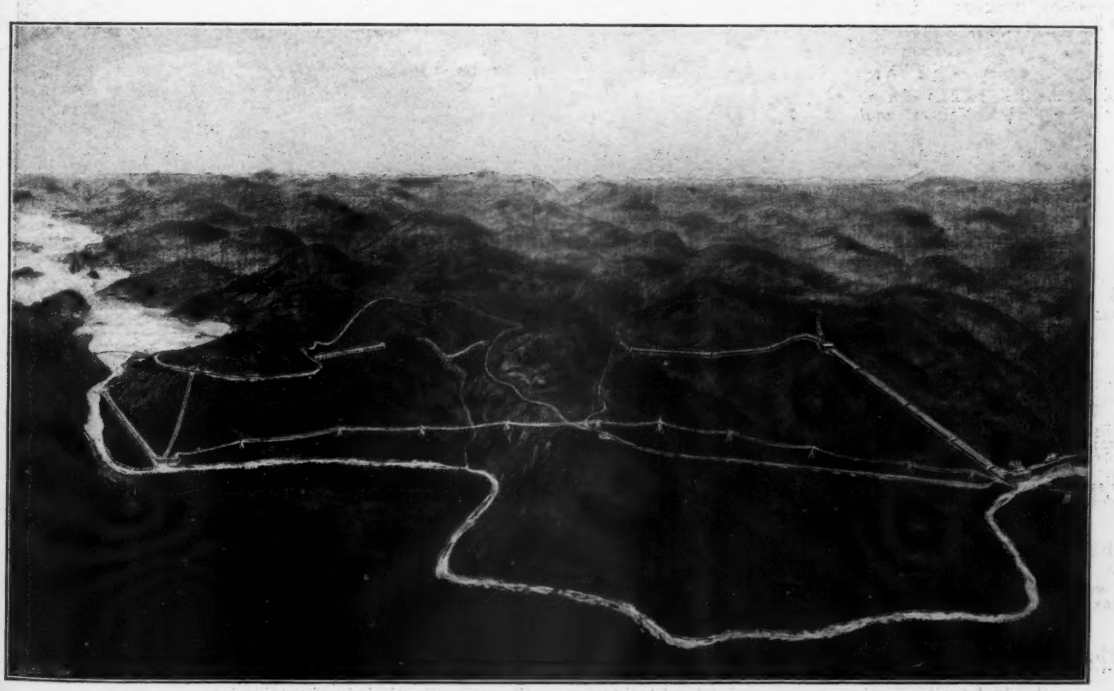


FIG. 2.—PANORAMA, RIO DAS LAGES, SHOWING PIPE LINES AND ELECTRIC TRANSMISSION LINES.

obtained from the State of Rio de Janeiro, the company acquired the right, if and when desired, to tap the neighbouring watershed of the Rio Pirahy, which ensures sufficient water to develop a total of 120,000 H.P. at Rio das Lages in the driest season.

The company is the absolute owner of the banks of the Rio das Lages, from a point some distance below the power house, and extending up stream to the highest points to which the water is backed by the dam, a total distance along the river of some 22 miles. The authority to use the hydraulic force of the river is derived, not only from the common law right, as owners of the river margins, but also from a concession of the Government of the State of Rio de Janeiro, the competent authority. This concession is perpetual, and in the form of a contract, and cannot be revoked, and no additional onus or obligation can be imposed on the company.

FIG. 3.—6,600-VOLT TRANSFORMER-VAULT CONNECTING UNDERGROUND CONDUITS.
These vaults are located 1,200 ft. apart, with ordinary manholes, spaced about 400 ft. apart between them.

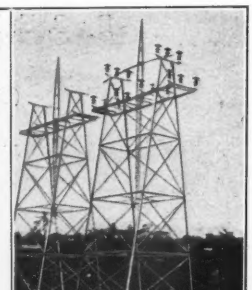


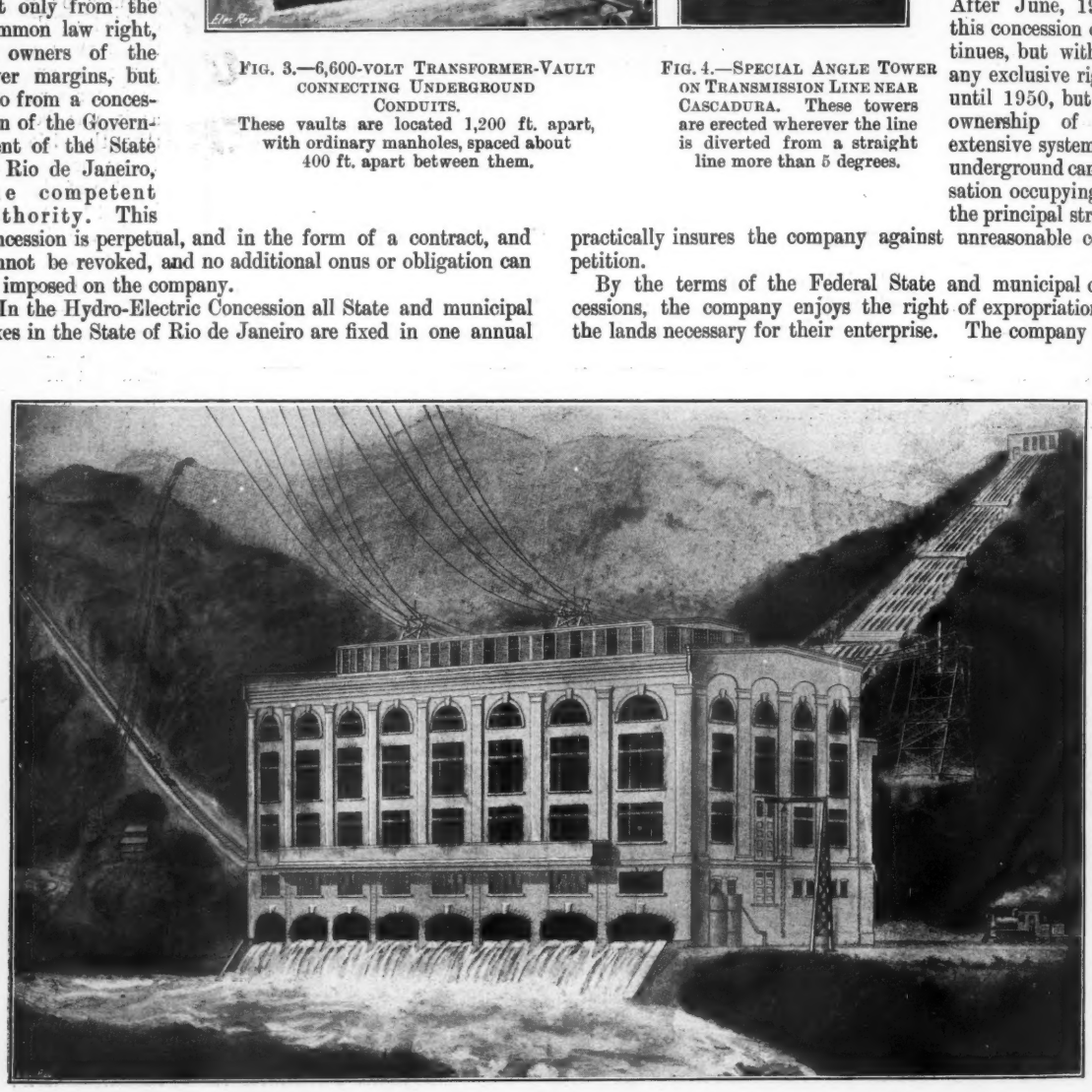
FIG. 4.—SPECIAL ANGLE TOWER ON TRANSMISSION LINE NEAR CASCADURA. These towers are erected wherever the line is diverted from a straight line more than 5 degrees.

In the Hydro-Electric Concession all State and municipal taxes in the State of Rio de Janeiro are fixed in one annual contribution for a period of 50 years; power is given to supply electricity throughout the State, and to all the cities and towns thereof, and it is clearly understood that if any new favour in the future be given by the Legislature to any hydro-electric enterprise, the same shall be extended to this company. Thus the obligations of the company in regard to construction, operation and maintenance of the works, are reasonable and free from vexatious restrictions. The company also owns all the necessary marginal land for a future development at Sapucaia, and the concession above referred to also extends to this enterprise.

The company also acquired from the Federal Government and the Municipal Council concessions giving the exclusive right to furnish electrical energy, generated by hydraulic installation, within the city and Federal district, and the right to construct and maintain an overhead and underground system of canalisation for distributing the electric energy for power and lighting, subject only to certain rights of the gas company, to which we refer later. After June, 1915, this concession continues, but without any exclusive right, until 1950, but the ownership of the extensive system of underground canalisation occupying all the principal streets practically insures the company against unreasonable competition.

By the terms of the Federal State and municipal concessions, the company enjoys the right of expropriation of the lands necessary for their enterprise. The company was also conceeded the right of exemption from duty on all material imported for construction purposes.

In March, 1907, it was deemed advantageous to immediately construct a preliminary hydro-electric plant at Rio das Lages. The main upper fall of the river was used for this purpose, and a temporary power house of wooden frame and corrugated iron was built. This plant had a capacity of 3,400 H.P., and was utilised for furnishing all the light-



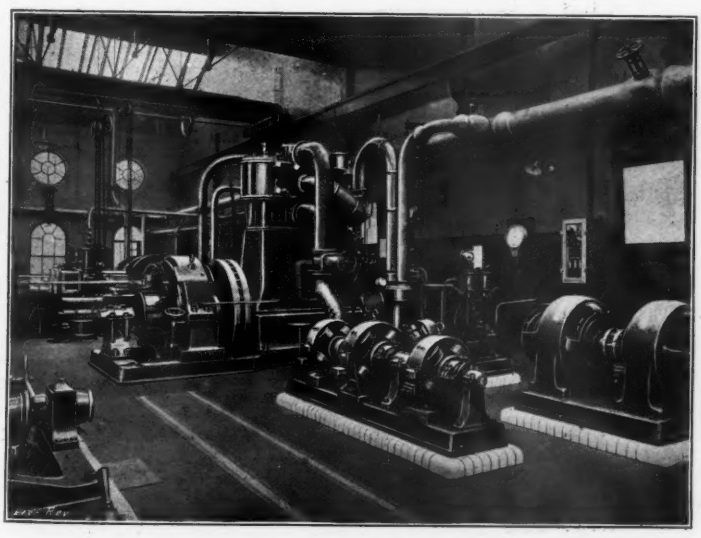
RIO DAS LAGES POWER HOUSE. VIEW SHOWING PENSTOCKS, RAILROADS, AND TRANSMISSION LINES.

ing and power required for the construction work at Rio das Lages, as well as supplying light and power in Rio de Janeiro over the permanent transmission lines which were then already completed. Meanwhile, the main installation at Rio das Lages was being rapidly constructed. A concrete and masonry dam is built at the top of the falls, 115 ft. in height and 92 ft. in thickness at the base. This structure stands on a solid granite foundation, both at base and sides, and closes up the valley above, in which is impounded sufficient water to guarantee under the present development a maximum load of at least 50,000 H.P.

The total area of the lake above the dam is about 7¼ square miles. The water passes through controlling gates and riveted steel pipes 6,000 ft. in length from the reservoir to the distribution receivers immediately above the power house. From the receivers are led out six 36-in. pipes about 1,900 ft. in length, each to its own turbine. These pipes are laid on a steep grade, the receivers being located about 900 ft. above the power station. The total head with the reservoir full is about 1,030 ft. from the spillway level on the dam, the nozzles of the turbines representing a pressure of 445 lb. to the sq. in. At the power house are installed six main wheels, each developing about 9,000-H.P. maximum capacity, to which are connected generators of the stationary armature and revolving field three-phase type, designed to operate at 50 cycles, with a normal voltage of 6,000 and a maximum pressure of 6,600 volts. The voltage of current from the generators will be stepped up to 80,000 volts, with a maximum overload potential of 88,000 volts, for transmission to Rio de Janeiro over the four transmission circuits.

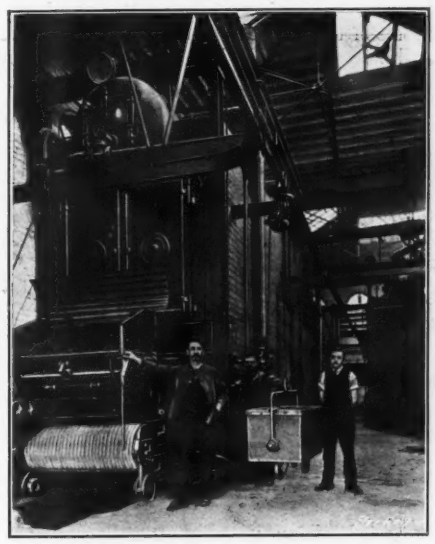
There are two separate lines of transmission to the city, each with two separate circuits, located on the private rights-of-way of the company, acquired by purchase. The company has constructed some 220 miles of underground canalisation under the streets of the city, has built 69 large transformer and distribution chambers under the pavements, and has already installed some 1,300,000 ft. of cable. We are pleased to say that the company's lighting system is believed to be one of the most perfect in the world, this probably being the first occasion on which an entirely modern electric lighting system has been installed throughout a large city, unhampered by any previous antiquated installation or plant.

The company acquired the control of the following companies :—The Companhia de Sao Christovao (Tramway) ; the Companhia de Carris Urbanos (Tramway) ; the Companhia de Villa Isabel (Tramway) ; the Companhia de Tijuca (Tramway) ; the Companhia de Corcovado (Tramway) ; the Companhia Jardim Botannico (Tramway) ; the Société Anonyme du Gas de Rio Janeiro ; the Brazilianische Elektricitats Gesellschaft (Telephone Co.).



WHITEHAVEN ELECTRICITY WORKS :—BROWETT, LINDLEY-P.D.M. CO. STEAM DYNAMO, BOOSTER-BALANCER AND MOTOR-GENERATOR. (See p. 990.)

Telephone Service.—This service is operated under a concession granted by the Municipality of Rio de Janeiro to Brazilianische Elektricitats Gesellschaft, a German Company, the entire capital stock of which was owned by the Rio de Janeiro Telephone Co. (A Maine, U.S.A., Corporation) with a capital stock of $1,000,000, but which is now owned by the Rio de Janeiro Tramway, Light and Power Co. This company has reconstructed the old telephone service, the greater part of the lines having been rebuilt, and a large amount of new work has been done to meet the growing demands in the suburban districts. The central substations in the Villa Isabel and Jardin Botanico districts have been completed, bringing up the total switchboard capacity to 8,700 lines, which shows a very large increase on the previous years.



WHITEHAVEN : BABCOCK & WILCOX BOILER, WITH CHAIN-GRATE STOKER AND OVERHEAD RUNWAY.

The Gas Service.—This company controls the gas service of Rio de Janeiro through the ownership of the entire capital stock of the Rio de Janeiro Gas Co. (also a Maine corporation), which, in turn, owns over 90 per cent. of the securities of the Société Anonyme du Gaz de Rio de Janeiro, which is a Belgian corporation and the owner of the concession and plant in Rio de Janeiro.

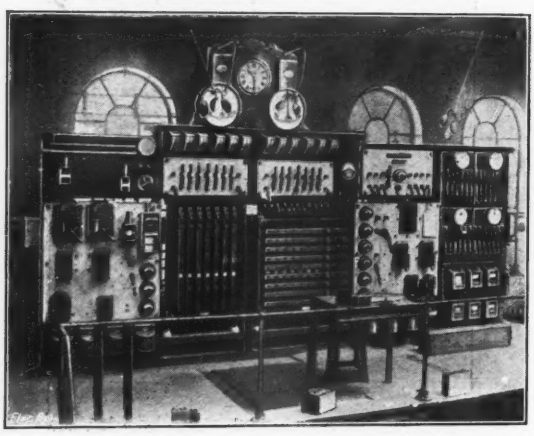
The concession gives the company the exclusive right to supply gas for all purposes until 1945, including the lighting of the streets of the city during this period. The concession also gives the company the right to supply electric energy for public and private lighting, with a monopoly for public lighting until 1945 and for private lighting until 1915, after which the concession for private electric lighting continues without exclusive rights until 1945. Under this concession the company is supplying some 5,200 arc lamps for street lighting.

A new concession was granted the company for gas service ; it included a large area of land, comprising about 20 acres, which is very favourably located for the delivery of coal, adjacent to the water front. The new plant which the company has constructed, is of the most modern design, advantage having been taken in its construction to utilise the most advanced practice in gas engineering in every department. Particular attention has been paid to the use of machinery in place of manual labour wherever possible, in order to reduce to a minimum the cost of the latter, which in undertakings of this character, in a tropical country, is necessarily high. The new works have a capacity equal to

twice the present consumption, and can be further extended as the demand requires at a moderate cost, so that the future requirements of the city are fully provided for. The use of gas for fuel purposes is being developed in a systematic manner, and it is expected that the consumption for this purpose will considerably increase within a short time.

Our readers will now have an idea, more or less, of the important undertakings which have been, and are being, carried out in Brazil. We reproduce some illustrations, to give our readers a better idea of the Rio Company's works, and to show some of the difficulties which were encountered.

This will also give our readers an idea of the character of the electrical opportunities that are available in Brazil. We



Whitehaven: Original Main Switchboard.

may venture to state that there are many towns in Brazil without electric tramways and electric lighting, and also without a good telephone service.

(To be continued.)

THE WHITEHAVEN CORPORATION ELECTRICITY WORKS.

The Whitehaven Corporation Electricity Works is amongst the oldest of the municipal electrical undertakings in this country, the public supply of electricity having commenced on September 2nd, 1893, almost exactly two months after the opening of the Manchester electricity works. The first instalment of plant, to the designs of the late Dr. Hopkinson, consisted of six Willans-Crompton 35-kw. d.c. sets, supplying the outers of the three-wire system, at declared pressures of 210 and 105 volts respectively. The balancing was for some time carried out by means of a bank of lamps on the switchboard, and change-over switches on the premises of the large consumers, an arrangement which would hardly commend itself to the engineers of to-day. Whitehaven is said to have been the first town in the United Kingdom to have been electrically lighted throughout, every gas lamp in the town, and on the harbour, to the number of about 400, having been changed over to electric lighting during the summer of 1893.

The mains were supplied by Messrs. Siemens Bros. & Co., the public lighting mains, which are entirely separate from the private mains, consisting of rubber cables laid bare in brick troughs. The supply for this purpose was at 220 volts, two-wire, divided into five districts, and the mains were arranged on the tree system with the lamp-posts or brackets arranged two in series, a third or series wire connecting each pair of posts or brackets; in the case of an odd post a two-light fitting was used. The lamp voltages varied according to the distance from the works, there being a drop of some 40 volts between the switchboard and the outer ends of the system.

It is interesting to note that this system and pressure are in use at the present moment, and have been found most adaptable for the use of the tungsten-filament lamps working two in series, an interesting testimony to the value of the work done by Dr. Hopkinson nearly 20 years ago.

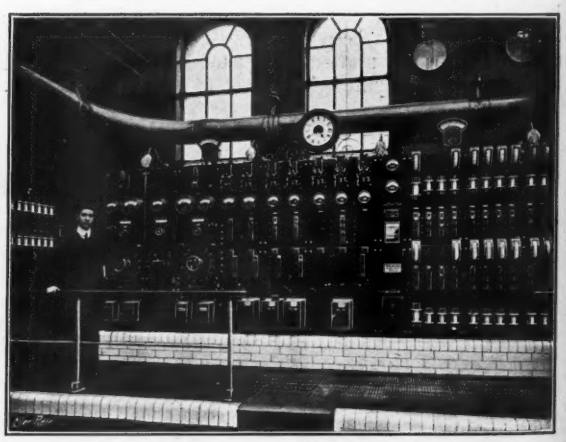
The three-wire private mains consisted of three single rubber-insulated cables, drawn into earthernware drain pipes, services to consumers being apparently made by breaking into the pipes and making a rough brick-work box, covered by a flagstone and buried.

As might be expected in the light of modern experience, these mains did not have a very long life, and before long it became necessary to relay the whole of them, and to provide further extensions of the plant at the electricity works.

For this purpose two loans were raised, one in 1899 of £9,858 for 20 years for plant extension, and another in 1901 of £9,900 for 10 years, with which the whole of the mains were relaid. The private mains consisted of Callender's bitumen cable in wood troughs filled in with bitumen, and the public mains of Siemens lead-covered rubber-insulated cable drawn into the existing brick troughs. At the same time the works were extended by two Willans-E.C.C. 83-kw. generating sets, and two Babcock & Wilcox double-drum water-tube boilers were installed, whilst the switchboard was enlarged and reconstructed on a wooden framework. It should be noted that no boiler house accessories were provided such as economisers, mechanical stokers, superheaters, or even feed pumps. Saddled with the very heavy capital charges of the above loans, it is hardly to be wondered at that the electricity undertaking was unable to make both ends meet.

In 1909 further loans were raised to provide a surface condensing plant, taking the place of the old ejector condensing plant using town's water, and to provide a new battery with switchboard and battery-charging booster, the old batteries being worn out and there being no satisfactory charging arrangements. In spite of these improvements, it became evident that by reason of the steady increase of the output the supply could not much longer be economically or safely maintained with a number of small engines, six out of eight of which had been in regular use since 1893, and with two water-tube boilers only, with no boiler-house accessories.

After careful and prolonged consideration, the Corporation therefore decided in May, 1910, to proceed with the scheme laid before it by the borough electrical engineer, Mr. B.



New Main Switchboard.

Sankey, and the following plant was installed to his specification, and under his supervision :—

Water-tube boiler, complete with chain-grate stoker and superheater	Babcock & Wilcox, Ltd.
Two superheaters fitted to existing Babcock & Wilcox boilers	" "
Green economiser	E. Green & Son, per Vulcan Engineering Co., Whitehaven.
Boiler house runway	Vaughan & Sons, Manchester.
Stokers for existing boilers	E. Bennis & Co., Ltd.
Pipework and Weir feed pump	J. F. Stout & Sons, Whitehaven.
New main switchboard	Whipp & Bourne, Castleton.
Motor-generator	Electric Construction Co.
250-kw. generating set	Browett, Lindley & Co., with Phœnix Dynamo Co.'s dynamo.
Balancer	Phœnix Dynamo Co.
Cables	Callender's Cable and Construction Co.

The v
as the la
were un
being en
mains, a
motor-g
pressure
lighting
440 volt
lamps th
inter-pol
bus-bars
coupling
lighting
bearings
83·8 per
The b
ing set
gear, sup
ment ha
without
improve
engineer
dynamo
bus-bar
35-KW.
to make
lathe and
The n
lead-cove
residenti
residents
original
nine feed
of old-fa
the netw
fuses, wh
at any ti
Now t
work, it
policy th
and pay
financial
the annu
and Whi
having t
undertak

CO

THE con
accompli
discharge
varying t
former m
points co
A cen
at the sp
lift and
fugal pum
speed con
pumps, s
square of
pump is
the pump
as this f
fluid, it
difficultie
instance
condenser
fugal pum
The m
installed,

The whole of the building and foundation work, as well as the laying of the cable extensions to two new districts, were undertaken by direct labour, a temporary assistant being employed to prepare detail plans, make plans of the mains, and give general assistance with the new work. The motor-generator was installed to convert the private lighting pressure of 420 volts 3-wire to 220 volts 2-wire for public lighting purposes, the pressure being once more reduced from 440 volts to 220 volts by the installation of metallic-filament lamps throughout the town. This machine consists of an inter-pole motor taking current off the private lighting bus-bars at 420 to 440 volts, and coupled through a flexible coupling to an inter-pole dynamo supplying the public lighting at 220 volts, both machines being fitted with ball bearings. The efficiency of the combination at full load is 83·8 per cent.

The balancer, as seen in the illustration of the new generating set on p. 989, is equipped with an automatic regulating gear, supplied by Messrs. Bertram Thomas. This arrangement has now been in successful use for over 12 months without giving the slightest trouble, and has made a great improvement in the steadiness of the supply pressure, the engineer-in-charge having merely to attend to the main dynamo regulator, whilst the balancer equally divides the bus-bar pressure under all conditions of load. Of the old 35-kw. Willans-Crompton sets, three have been disposed of to make way for a workshop, containing a 6½-in. Selson lathe and a Selson drilling machine.

The new mains consist of some two miles of bitumen and lead-covered distributor cables supplying two important residential districts, in which a considerable number of residents have already availed themselves of the supply. The original network has also been improved by the fixing of nine feeder and distribution pillars in place of a large number of old-fashioned disconnecting pits and boxes, thus enabling the network to be divided into districts interconnected by fuses, which can quickly and easily be examined or changed at any time and in any weather.

Now that the whole of this new plant is installed and at work, it is hoped that with a more vigorous and progressive policy the undertaking may soon be established on a sound and paying basis. After the completion of the present financial year, the capital payments will also be relieved of the annual charge of £1,200 on the £9,900 10-year loan, and Whitehaven will be relieved of the unpleasant position of having the highest percentage of capital repayments of any undertaking in the United Kingdom, viz., 5·53 per cent.

CONTROL OF CENTRIFUGAL PUMP MOTORS.

By JOHN S. LEESE.

The control of the discharge of centrifugal pumps may be accomplished in two ways: either by the throttling of the discharge pipe by the manipulation of a valve therein, or by varying the revolutions per minute of the impeller. The former method needs no further elucidation here, but some points connected with the speed control may be dealt with.

A centrifugal pump will operate at its highest efficiency at the speed for which it is designed, and with its normal lift and discharge. The efficiency curve of a typical centrifugal pump brings this fact out very clearly. Unfortunately speed control cannot be applied to all and sundry centrifugal pumps, since the lift does not vary directly as, but as the square of, the speed. In services in which the centrifugal pump is applied to circulate a fluid, however, the head against the pump will be for the most part due to pipe friction, and, as this friction varies as the square of the velocity of the fluid, it is evident that this proportion will eliminate the difficulties of speed control to a large extent. A common instance of such a service may be found in cases of surface condensers whose circulating water is supplied by a centrifugal pump.

The majority of the centrifugal pumps installed, and being installed, are direct driven by electric motors. Dealing first with cases in which a variable speed is desirable, two classes of motor may be applied; first, direct-current shunt motors controlled as to speed by shunt field control, and, secondly, variable-speed induction motors controlled by varying the frequency. The first type of motor will be extremely efficient in the service under discussion, but, since the motor will have to operate at its normal output at high speed, it will necessarily be somewhat large. All variations in the speed of the set will be to speeds below the normal, since it is impracticable to "force" a centrifugal pump discharging into long or tortuous piping systems. Another method of speed control may be accomplished by using armature control, the speed varying almost inversely as the cube root of the power. The result of this will be that only a small resistance will be necessary, which will reduce the size of the motor required below that of the shunt-field controlled type first mentioned. The relative costs of the two systems of control will be in favour of the armature-control system unless the speed variation is small—say, not exceeding 20 per cent. In this case the shunt-field control system will be but little—if any—more costly, and the superior efficiency available with this type of control will counterbalance any small difference existing in the prices. The results obtained with the second class of motor, namely, the variable-speed induction motor, are very similar to those due to direct-current motors with armature control, but they can only be accomplished by frequency variation.

There are three classes of electric motor which are used in ordinary centrifugal pumping work; first, the constant-speed alternating-current induction motor; secondly, the variable-speed induction motor; and thirdly, the direct-current shunt-wound motor. The starting-up method employed with the second type is sufficiently self-evident and needs no description. The starting-up of the first type of motor may be accomplished on about 55 to 65 per cent. of the normal voltage, since the torque required with the discharge valve closed will not greatly exceed half-load. When the motor-driven set is being brought up to speed, the maximum current required will never exceed twice the normal full-load current under these conditions. When the set has been brought up to speed, the normal voltage may be thrown on, the resulting change in the ammeter reading being very small. The opening of the throttle valve will introduce normal conditions. There are two methods of starting up alternating-current induction motors, neither of which possesses any very great advantages over the other sufficient to justify its exclusive adoption. Either a double-throw switch or a single point auto-starter may be beneficially used. The starting-up of direct-current shunt-wound motors necessitates a greater number of starting notches on the controller.

The Midland Electrical Engineers' Ball.—Arrangements have been made for the holding of a Midland Electrical Engineers' Ball at Birmingham, on Friday, January 12th, 1912, in the Grosvenor Suite, Grand Hotel. It is under the care of a strong and representative local committee, with Mr. R. A. Chattock as its chairman, and the Lord Mayor of Birmingham and the Lady Mayoress are patrons. Mr. Howard Foulds, 14, Dale End, Birmingham, is the hon. treasurer, and Mr. H. B. Matthews, of Winchester House, Victoria Square, Birmingham, is the hon. secretary. The tickets are one guinea each, inclusive of everything. We understand that the best band in the city has been secured, and that excellent arrangements have been made with the Grand Hotel for catering and decoration. It is believed that there are a goodly number of electrical engineers in London, Manchester and elsewhere who will desire to avail themselves of an opportunity of meeting their Birmingham friends under such conditions, and we can assure them of a hearty welcome and a really enjoyable time.

The Physical Society's Annual Exhibition.—This exhibition, which is to be held on Tuesday, the 19th inst., at the Imperial College of Science, South Kensington, will be open from 3 to 6 p.m. and from 7 to 10 p.m. Prof. The Hon. R. J. Strutt, F.R.S., will give a discourse at 4.30 and again at 8 p.m. on "Electric Discharge and the Luminosity which Survives It." Some 30 firms will be exhibiting. Invitations have been given to the Institution of Electrical Engineers, the Faraday Society, the Optical Society and the Röntgen Society. Admission in all cases will be by ticket only, and therefore members of the Societies just mentioned (including also the Physical Society) desiring to attend the exhibition should apply to the secretary of the Society to which they belong.

FORTHCOMING EVENTS.

Electro-Harmonic Society—Friday, December 15th. At 8 p.m. At the Holborn Restaurant. Smoking concert.

Institution of Mechanical Engineers.—Friday, December 15th. At 8 p.m. Discussion on paper on "Double-cutting and High-speed Planing Machines," by Mr. J. H. Wicksteed.

Manchester Association of Engineers and Manchester Local Section of Institution of Electrical Engineers.—Friday, December 15th. At 7.30 p.m. At the Whitworth Institute, Manchester. Conversazione.

Institution of Municipal Engineers.—Saturday, December 16th. At 3 p.m. At 4, Southampton Row, W.C. Paper on "The Electric Trolley Omnibus System," by Mr. Horace Boot.

Physical Society of London.—Tuesday, December 19th. 3 to 6 and 7 to 10 p.m. At the Imperial College of Science. Annual Exhibition of Apparatus.

Institution of Electrical Engineers (Scottish Local Section).—Tuesday, December 19th. At 8 p.m. At the Heriot Watt College, Edinburgh. Paper on "The Heriot Watt College Laboratories," by Prof. F. G. Baily.

Illuminating Engineering Society.—Tuesday, December 19th. At 8 p.m. At the Royal Society of Arts. Paper on "Some Aspects of Railway Station and Goods Yards Illumination," by Mr. H. T. Harrison.

Finsbury Technical College Engineering Society—Tuesday, December 19th. At .m. At the Holborn Restaurant. Smoking concer .

THE ELECTRICAL ENGINEERS
(LONDON DIVISION).

Commanding Officer—Lieut.-Col. H. M. Leaf.

The following orders are issued :—

Monday, December 18th.—"A" Company. Technical work and musketry instruction (standard tests), 7 to 10 p.m.

Tuesday, December 19th.—"B" Company. Technical work and musketry instruction (standard tests), 7 to 10 p.m.

Wednesday, December 20th, 1911, to January 2nd, 1912.—Headquarters will be closed.

Urgent.—All members of the corps are requested to attend headquarters on their company night to sign Association Form 10, recently received from the County of London Association.

(Signed) P. H. Campbell, Capt. R.E. and Adjt.,
For Officer commanding L.E.E.

NOTES.

More About the Donuts.—On Thursday last we went down to Rugby to see what the "Donuts" could do—and incidentally to solve the mystery of the derivation of their curious title. To settle the latter first, we found that they were defined in the programme as "merely the organised D.O. nuts"—the nuts, that is, mostly employed in the drawing offices. Apparently the Donuts are prepared to tackle any branch of science, art or literature, and if they are always as successful as they have been in this their first undertaking, they will undoubtedly be entitled to the award of what, after their fashion, we may call the B-th bun. As the bulk of the properties, the whole of the scenery and the admirable stage effects were the work of the performers themselves, and the play extended over six acts with as many different scenes, which were admirably staged, it will readily be seen that an immense amount of labour had to be accomplished by the worthy nuts. Their sign is a bright hexagon nut, which we hope is not supposed to be screwed, and their motto is the defiantly aggressive one "Ride, si sapis."

The play "The Adventures of Eddie Currant" was written by Mr. T. H. Relton, who is also the Donuts' hon. sec. and treasurer, as well as publicity manager. It covers the life-history of the hero from his abduction at a tender age to his attainment of worldly success and restoration to his rightful position; the intermediate stages are represented by scenes in a technical school, in a drawing office at the P.I.P. works, in the engineers' office of the same, and in a grocery store, the final scene being laid in the verandah of West Hyng House, where Eddie has just returned from his honeymoon. The career of a smart young engineer, armed with a sufficiently "guid conceit" of himself and plenty of bluff, through the technical departments to the sales department, and thus to fame and fortune, is cleverly satirised, and great credit is due to the performers, who obviously devoted their whole attention to the play and did their very best. While we cannot enlarge at length upon the various *rôles*, we have pleasure in complimenting Mr. B. Shepherd upon his excellent singing, and in congratulating Mr. A. G. Worth on his life-like impersonation of the scheming typist, Miss Teresis Loupe. Honourable mention must also be accorded to Messrs. H. C. Heath as Bill Miker, a coster; W. E. Elkins as Mother Goose, a witch; F. G. Ketelbey as Mr. Winkle, the old draughtsman; and W. B. Cornes as Higgins, the office boy, as well as in other parts. Mr. A. King, as Snatcher, was the most realistic sneak-thief that we have ever seen, and must have seriously jeopardised his reputation for honesty by his life-like get-up. The title *rôle* was very conscientiously filled by Mr. C. W. Peyton.

Circumstances, we believe, prevented a complete dress rehearsal from being held, and all the more credit is therefore due to the actors for their successful *début;* the same reason probably accounts for the fact that some of the monologues were not cut down to more manageable proportions. Apart from this, we have nothing but praise for the efforts of the D.O. staff of the B.T.-H. Co. to entertain their colleagues and the public, and admiration for their pluck in starting with so bold an enterprise.

Copper.—Messrs. Merton's statistical circular for the end of November, 1911, shows a drop of 3,154 tons in the visible supplies for the month. This is made up of 3,560 tons withdrawn from stocks in English ports and 219 tons less at Havre, balanced against an increase of 625 tons more afloat. This drop is about 1,000 tons above average. Supplies from North America to England are low, though fairly strong to other European countries. From Spain, also, they are below the average, while shipments from Chile and Australia are both rather low. Total deliveries, however, keep fairly high at 39,416 tons. Stocks in Rotterdam have fallen off 1,200 tons, and in Hamburg (estimated) 1,300. Stocks in American producers' hands at the end of October were 2,632 tons lower than for end of September. The world's supplies at the same date are, at 122,103 tons, some 8,136 tons lower than for end of September. These are lower now than they have been since January, 1909.

Tuned Cablegraphy and Wireless Telegraphy.—On Monday last we attended a demonstration of the systems propounded by Messrs. A. T. M. Johnson and F. H. Varley for "cheap cable messages and secret wireless telegrams," at 37A, Finsbury Square, E.C. The apparatus was arranged round the sides of a small room, and consisted mainly of instruments used to demonstrate the principles employed by the inventors, being of a more or less experimental character.

The idea at the base of both systems is that of syntony obtained by means of tuned reeds; each letter or numeral is represented by a sending and a receiving reed of identical pitch, and it is claimed that the tuning is so sharp and the system is so free from interference between signals of only slightly different pitches, that 49 differently tuned signals can be obtained within the range of one semitone. Obviously, in theory at least, each letter or other signal could be transmitted by depressing a given key on a suitable keyboard, which would actuate the corresponding sending reed, and the signal would be picked up at the receiving station by a similar reed connected to a recording device. Thus a message could be transmitted as fast as it could be written on a type-writer.

But while this is very pretty and plausible, it fails to take due account of practical conditions. And this is, perhaps, not surprising in view of the fact that the chief inventor appears to be Mr. Johnson, who was formerly a Professor of Music in Victoria, and therefore could hardly be expected to be fully conversant with the working of submarine cables. That Mr. F. H. Varley, who is associated with Mr. Johnson in the matter, did not enlighten his colleague is less easily explained.

The demonstration consisted for the most part of elementary explanations of the behaviour of tuned and untuned reeds, with which our readers need not be troubled. Unfortunately, even on a subject so closely related to his own profession, Mr. Johnson's views are unreliable, for one of the essential features of the system is that the rate of vibration of reeds is uninfluenced by variation of temperature. He essayed to explain the statement by pointing out that change of temperature would cause change of all the dimensions of the reed in the same proportion, and claimed to prove it by an experiment with a pair of tuned reeds and a saucepan of hot water, which carried conviction to no engineer's mind. But the professor appeared to be unaware that the frequency of vibration of a reed varies as the thickness, and inversely as the square of the length, so that proportionate variation of dimensions with temperature *must* cause change of pitch, while the decrease of elasticity with increase of temperature aggravates the error.

As a matter of fact, reeds do change their pitch with change of temperature, though to a less extent than stretched wires, no doubt. It is difficult to see why the inventors did not propose to keep the pitch of the reeds invariable by keeping the temperature constant, as can easily be done, instead of going out of their way to introduce a fallacy at the start. Let us assume that this is done. Can oscillatory currents be transmitted through long submarine cables? It is common knowledge that this is impossible, except at a slow rate, depending upon the length and capacity, &c., of the cable. In the case of the Atlantic cable, to which Mr. Johnson referred, the highest speed attainable is in the neighbourhood of 12 or 13 signals per second (50 words per minute). To make an indicator responsive to the excessively attenuated signals received across the Atlantic, its control would have to be reduced to the minimum, and in order to accumulate by resonance sufficient motion to actuate a relay, however sensitive, the signal would have to be maintained for an appreciable fraction of a second for several waves to arrive; moreover, with so short a train of waves close tuning could not be possible. Hence, not only would the time taken in transmitting a single letter by resonance be comparable with that at present required to transmit the Morse signals making up a letter, but that accuracy of tuning claimed by the inventor would be utterly lost. How then could the 49 different tuned signals be compassed within a semitone? To raise the frequency to a pitch at which sharp tuning would be feasible is rendered impossible by the physical characteristics of the cable.

Experiments such as that shown, in which audible signals were transmitted through 58,000 ohms, are utterly meaningless, as the all-important element of static capacity was absent.

The only test that is worth consideration is that of transmission through a long cable actually laid at the bottom of the sea, or its equivalent, and in reply to a question, Mr. Johnson admitted to our representative that this had never been done with his apparatus.

The wireless part of the affair was more directly in Mr. Varley's hands. While utilising the same principle, it is claimed to be an untappable system. A stream of waves is emitted under the control of a reed slightly out of tune with the receiving reed, which is therefore unaffected: the signals are transmitted by the aid of a key which modifies the sending reed, so as to bring it precisely into tune with the receiver, which is, therefore, affected when the key is depressed. It is claimed that an outsider would not be able to distinguish the very slight change of pitch which marked the sending of each signal. We doubt this, under practical conditions. But even if it be true, the fact that a station thus sending out a continuous train of waves seriously interferes with all other stations within range is a very grave objection. That it does so we know from the mouth of Mr. Johnson, who informed our representative that a certain English coast station was, to use his own expression, "paralysed" and unable to receive any signals while the Johnson-Varley apparatus was at work. A "continuously decohering coherer" using iron filings was exhibited for use in connection with the system; this is surely a "back number."

The reed tuning system, Mr. Johnson said, could be used to send and receive several messages simultaneously through one cable or wire; no doubt this is true within the limits prescribed by the conditions to which we have referred.

We have said enough to show that, in our opinion, the inventors are dealing with matters with which they are not at all conversant, and we fear there is a painful disillusionment awaiting them. Fortunately, as one of the promoters informed the audience, they "are not out for money," as they claim to have a financial backing. Appearances belied the statement; but, at all events, they are unlikely to obtain support in electrical circles.

Faraday House Students' Society.—Dr. Alexander Russell has been appointed president of this Society; Mr. E. B. Ritson, vice-president; Mr. F. T. Chapman, B.Sc., treasurer; and Mr. B. P. K. Walsh, secretary. The next meeting will be held on January 17th, 1912, at 4.45 p.m., when Mr. E. B. Ritson will give an account of his personal experiences as an engineer with the High-Tension Hydro-Electric Power Co. at Necaxa, Mexico.

Northampton Institute.—On Friday evening last the annual prize distribution and students' conversazione took place at this Institute. Sir Wm. H. White was present to distribute the prizes and certificates to successful students, but before that item in the programme was reached, a more than usually interesting report was read by the Principal, Dr. R. Mullineux Walmsley, on the work of the 1910-11 session. It appeared therefrom that once again the necessity for enlarging the buildings to provide increased accommodation was being realised. He said that the total number of individual students diminished from 2,163 to 2,035. The diminution, however, was confined practically to a single department, and was due to a specific reason beyond the control of the Polytechnic. The department referred to was that of telegraphy and telephony, where the educational work was still disturbed by the near approach of the date for the taking-over of the work of the National Telephone Co. by the Post Office. The percentage of apprentices attending the evening classes increased to 40 per cent., as against 39 per cent. in the preceding session. The day classes and courses were well maintained, and for the seventh year in succession the Principal was able to place, without any payment of premiums, the whole of the second and third-year students in commercial workshops during the summer. The reports received from these workshops continued to testify in many ways to the appreciation with which the students trained in the day courses at the Polytechnic were regarded by the firms which had an opportunity of testing their attainments. New firms were added to the list during the session, so much so that more vacancies were offered to the Principal than he had students available for. As a further mark of the success of the day courses in engineering, some of the fourth-year men were engaged for permanent employment as early as Easter, although they were not at liberty until July, and on the electrical side the number of vacancies in July available for students completing their course was fully double the number of students qualified to fill them. The appreciation of employers was not confined to the day courses, but extended to the evening classes. Letters were frequently received testifying to the influence which the work done in the classes had upon the commercial work in the industries dealt with. After alluding to the laboratory and workshop classes in aeronautics, the Principal said that with regard to the Board of Education's examinations, although the whole of the work done in the classes was recognised by the Board of Education, only the examination in the subject of magnetism and electricity was prepared for in the Polytechnic, and that only in the classes which were confined to Post Office telegraphists and telephonists. The bulk of the work of the Polytechnic was appraised by the Board of Education by inspection and not by examination, and exceedingly favourable reports had been received during the session upon that work, the appraisement taking the form of a substantial increase in the block grant on the work of the evening classes, which was revised triennially by the Board.

Sir Wm. White, before distributing the prizes, delivered a brief speech, in which he said that as a result of his visits to educational institutions in this and other countries, he was much impressed and greatly delighted with the arrangements made at the Northampton Institute for the instruction of students. Any manufacture or industry must have a greater chance of success if all the workers were intelligent and well-informed. Rule-of-thumb would not prevail in these days of strenuous competition. It had been the fashion to talk about the special training for captains of industry—he did not know what that meant. His experience was that captains of industry did not get to their position by mere heredity; they were not people who could be picked out at the beginning of their lives as "future captains of industry." He had known some who had everything in their favour, and were picked out in that way, but who never attained the real position indicated. There was a selective process going on in all those matters, and they might put a man in a big position, and give him a title wonderful to read; but if he could not carry on the responsible duties of that position he would not be there long. We lived in a country where a career was open to any man or woman who would make the effort and deserve success. Sir William later referred to the question of examinations, and approved of the object of the Institute to train students to be thinkers in the careers that they had chosen rather than to fit them to pass examination tests. Some of the best and ablest men and women were utterly at sea when they sat down to an examination.

Explosion on a Battleship.—An explosion occurred on the new battleship *Orion* at Portsmouth on Tuesday last, under unique circumstances, and resulted in severe burns to a large number of men. The electrical equipment was being put through its trials, and one of the generators had satisfactorily passed the tests. A second dynamo was then started, and ran for a short period, when there was a violent explosion, and some 20 men who were present in the compartment were more or less severely burnt. The accident is attributed to the ignition of vapour from the oil wells of the armature bearings, but no definite information is available, and the compartment has been closed pending official inquiry. Those injured included several officers and men belonging to the *Orion* and others. Among them were Messrs. James Pringle (electrical engineer, Admiralty), A. Franklin (assistant electrical engineer), W. Green (inspector of electrical fitters), T. Metcalfe (chargeman of electrical fitters), H. Driver, W. Richards and J. Willis (electrical fitters), W. Rycroft and W. Ward (apprentices). It is believed that the injuries are not dangerous. Most of the sufferers were removed to Haslar, the rest being treated in the dockyard surgery.

It will be remembered that, some years ago, an explosion took place at Southport electricity works, due to the oil in the crank chamber of a vertical engine having a low flash-point. This is the only similar accident that we can call to mind.

Glasgow Electricity Department.—The officials of the above department held an "At home" on December 8th in St. Andrew's Halls. The *Glasgow Daily Herald* says that there was a large attendance of members of the electrical and engineering professions in Glasgow and the neighbourhood. The guests were received by Councillor Willock, convener of the Electricity Committee of the Corporation, and Bailie W. B. Smith, sub-convener. An enjoyable programme of music, whist and dancing was carried through. The secretarial arrangements were in the hands of Mr. R. B. MacCall.

The Electro-Harmonic Society.—At the smoking concert which is to be held at the Holborn Restaurant (King's Hall) to-night (Friday) at 8 o'clock, Mr. Hugo Hirst will preside. The artists are as follows:—Vocalists, Mr. Joseph Reed (tenor), Mr. Albert Garcia (bass-baritone), the Fransella Wind Quartett. Solo flute, Mr. Albert Fransella; solo banjo, Mr. Olly Oakley; sketches at the piano, Mr. Kenna Lawson; humorist, Mr. Fred Curtis; magician, Mr. Louis Nikola; solo pianist and accompanist, Mr. Bernard Flanders, A.R.A.M.

Educational. — UNIVERSITY OF LONDON, KING'S COLLEGE.—A course of advanced lectures on "The Application of Electric Power to Mines and Heavy Industries" will be delivered by Mr. W. H. Patchell, commencing on Monday, January 15th, 1912. Further particulars are given in our advertisement pages to-day.

NORTHAMPTON POLYTECHNIC INSTITUTE.—Notice is given in our advertisement pages of a course of 10 advanced lectures in "Illuminating Engineering," to be commenced on Tuesday, January 16th.

Appointments Vacant.—Dynamo-attendants for the Birmingham Electric Supply Department (25s. 9d.); assistant in the mains department of the Derby Corporation; shift engineer for the Stockton-on-Tees electricity works (30s. 6d.); mains assistant engineer for Kilmarnock (45s.). See our advertisement pages to-day.

Institution and Lecture Notes. — ASSOCIATION OF MINING ELECTRICAL ENGINEERS (INC.) (SOUTH WALES BRANCH).—The ordinary meeting of this branch will be held at 5 p.m. on Saturday, December 30th, at the offices of Messrs. Haslam and Schontheil, Ltd., Windsor Place, Cardiff. The discussion on Mr. Chris. Jones's paper on "Earthing, Earth Plates and Earth Detectors" will be resumed, and a paper on "Shaft Signalling" will be read by Mr. E. E. Beadsmore. On December 16th, at 6 p.m., a lecture will be delivered by the president, Mr. Sydney F. Walker, at the Lesser Town Hall, Pontypridd, his subject being the "Threatened Shortage of Coal: What Engineers are Doing to Meet it, and what Electricity has Done, and is Doing."

INSTITUTION OF ELECTRICAL ENGINEERS (NEWCASTLE LOCAL SECTION).—At last Monday's meeting the presidential address by Mr. C. S. Vesey Brown, was delivered. The annual dinner is to be held on Wednesday, December 20th.

South African Institute of Electrical Engineers.—At the meeting held at Johannesburg on September 21st, Mr. W. H. Perrow (Member of Council), electrical engineer of the Nourse Mines, Ltd., was presented with the Institute's gold medal for his paper read last season, the subject being "Notes on the Application of Electricity to Medicine and Surgery, with Special Reference to X Rays and High Frequency Currents."

A paper was then read by Mr. A. H. O. Renner on "A Comparison of Costs between the Ward-Leonard and Three-Phase Winding Systems."

Physical Society of London.—At the meeting on November 24th, a paper on "The Maximum Value of the Electric Stress between Two Unequal Spherical Electrodes," was read by Dr. A. Russell. With equal spherical electrodes, the electric stress between them can easily be computed from known tables. When, however, they are unequal the calculation becomes so laborious that it is prohibitive to nearly every experimenter. The author develops formulæ for this case, by means of which, and of the formulæ for the capacity coefficients given in a recent paper to the Society, the calculation is very appreciably shortened.

Royal Institution.—On December 4th, at a general meeting, a resolution was passed returning thanks to Sir James Dewar, Fullerian Professor of Chemistry, who had redecorated and furnished the lecture room at his own cost, in commemoration of his having, on October 22nd, 1911, occupied the Chair of Chemistry as long as it was held by Faraday.

Association of Engineers-in-Charge.—On Wednesday a paper was read by Messrs. G. and J. R. Wilkinson on methods of dealing with losses in steam plant due to condensation. The authors emphasised the importance of removing the water of condensation regularly as it was formed, and of passing it back immediately at its highest temperature through insulated pipes to the boilers.

Institution of Civil Engineers (Students).—At the meeting held on December 1st, Messrs. J. and W. Legg read a paper entitled "Brake-Lining Coefficients of Friction," giving detailed results of their experiments on the relative values of several brake-lining materials, and the variation of the coefficient of friction between cast-iron and the material with the intensity of pressure and the relative velocity of the two substances.

Imports and Exports in November.—During last month there were increases in both imports and exports. The former advanced in value by £1,343,083, and the latter by £4,088,966, re-exports increasing by £375,623. The electrical goods and apparatus exported amounted to £320,184, an increase of £88,526; machinery advanced to £2,882,123 by £333,805.

Fatality.—An inquest was held on the 6th inst. into the cause of death of Walter Ernest Holliday, which occurred on the previous Monday at Messrs. Hall & Co.'s cement works at Beddington. The works are equipped with their own electrical installation which generates three-phase 220-volt current, and deceased was in the firm's employ as a boiler maker and labourer. On the day of the accident, according to the evidence of the manager, he was repairing a set of cement clinker elevators, and tried to come up from the elevator pit by stepping on a bucket and then between two girders, instead of going up the steps. He was holding an electric lamp, and when he fell it was smashed, so that, as his hand was in contact with it, the current must have entered his body. As soon as witness saw this he pulled the wire away, though he got a slight shock when he touched the body. Witness produced the length of wire, and an electric lamp similar to the one deceased was using, and explained how it was broken. He also showed the jury a plan of the pit, pointing out where the body was lying. Witness thought that when he touched the body he got quite as much electricity through him as deceased could have done. Questioned by Mr. W. E. Harding (Home Office), witness did not think the deceased fell as the result of a shock, as the lamp and the lead were under the body. Another witness stated that he tried artificial respiration until the arrival of the doctor.

Alfred Wilkinson said he saw Holliday go down into the pit with a light, and a few minutes after noticed him lying at the bottom. The lamp was broken, and a blue flame was round the terminals.

Dr. O'Hagan said he found that there were burns on the back of the right hand and on the left, and between the thumb and index finger of each hand and under the chin. The heart was very fatty and its condition abnormal. He did not notice any bruising, though there was a wound on the head, and could not say from the appearance of the body whether he had fallen or not. In his opinion death was due to an electric shock, and was probably accelerated by the condition of the heart.

The jury returned a verdict of "Accidental death."

It seems to us that the inquiry was unsatisfactory from an electrical point of view, for apparently no properly qualified electrical engineer had anything to do with the matter either with regard to examination or evidence. It seems not at all improbable that deceased got a shock from the flexible lead which he was carrying which caused him to let go his hold in climbing, and that he struck one of the girders in falling. Alternatively it seems possible considering the medical evidence as to Holliday's health, that in climbing he over exerted himself and fainted; in falling it would be possible for him to damage the lead, and in this way also to produce the effect of death from electric shock.

The Electrical Treatment of Tobacco.—Referring to the note on this subject in our last issue, to avoid misapprehension, we wish to make it clear that our criticism was directed only to the description of the process invented by Mr. E. J. Lushy. That the process actually does improve the flavour and keeping qualities of the tobacco was not denied, nor have we any reason to doubt it.

National Insurance Bill.—The following letter came to hand too late for our "Correspondence" columns:—

"Subject to the above becoming law, it is proposed to formulate an Association of Electrical Works Sick Clubs. The undersigned need hardly point out the advantages of such a society to keep our sick clubs together, especially amongst those who do not at present belong to any friendly society. There are too many details to go into which would interest all sick fund men, and cannot be discussed by correspondence. May we, therefore, through your columns appeal to all sick club secretaries connected with the trade (or others interested) to communicate with us, with a view of having a round table conference and getting the society formed. The promises we have received from several large firms in the country lead us to believe that such a society would be welcome.

"W. Mead, General Electric Co., Ltd., Witton, Birmingham.
"J. J. Scrivener, British Thomson-Houston, Rugby.
"G. T. Broad, General Electric Co., Ltd., Witton, Hon. Sec., *pro tem.*

"Witton Birmingham, *December 11th*, 1911."

Plating on China.—An interesting departure in electro-deposition work has been introduced into this country by the Harvey Electro-Chemical Co., of Laurence Pountney Hill, E.C. By means of a new process, based on the Marino patent, the company are now plating glass and earthenware, or even wood and other substances, and in such a way that the deposit forms a molecular union with the article being treated. The actual process is, of course, not disclosed, but so far as we could gather, it consists of treating the surface of the object to be plated—which must be unglazed—with a solution which permeates the skin and practically transforms it into a metallic base, on which by means of the ordinary electrolytic deposition process, but with a modified electrolyte, any of the usual metals, such as silver, gold, copper, bronze, or aluminium, can be deposited. The simplest application is appears to be for electro-plating earthenware teapots, jugs, &c., for providing silvered rims and handles, &c.; the metal sheaths which the process provides greatly strengthen articles of earthenware, which need not be discarded though cracked internally. The process is an inexpensive one, and the results appear to be decidedly effective. The company also undertake electro-galvanising, and we are given to understand that their process is a considerable improvement on the ordinary one.

Finsbury Technical College, O.S.A.—The sixth annual dinner was held at the Trocadero Restaurant on Saturday last, the chair being taken by the President, Mr. R. J. Wallis-Jones, M.Inst.C.E, M.I.E.E. A large gathering of the members of the Association attended. Excellent speeches were given by Sir John Wolfe Barry, K.C.B. (who proposed the toast of the O.S.A.), Dr. Silvanus P. Thompson, F.R.S., Dr. R. Meldola, F.R.S., Dr. G. T. Moody, and Mr. W. J. Tennant, M.I.M.E., F.C.I.P.A. An enjoyable musical programme was provided under the direction of Mr. Chas. B. Nadaud.

Parliamentary.—The Coal Mines Bill.—This Bill was considered in the House of Lords on Wednesday, and after amendment it was reported to the House.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*

Central Station Officials.—At a meeting of the South Shields T.C. on the 7th inst., Ald. Rennoldson moved the adoption of a recommendation of the Electricity Committee as follows:—

That the Town Council, on the occasion of Mr. J. H. Cawthra relinquishing his appointment of Borough electrical engineer to take up his appointment in South Africa, place on record its high appreciation of the services rendered during the past 10½ years by Mr. J. H. Cawthra in his capacity as Borough electrical engineer of this Corporation, and its testimony to the skill and ability shown by him as chief engineer of the electricity undertaking of the Corporation, and to the assiduous attention which he has devoted to the undertaking during the period before mentioned, and that a copy of this resolution be engrossed and presented to Mr. Cawthra with the corporate seal affixed thereto, that it be signed by the Mayor and countersigned by the Town Clerk.

Ald. Rennoldson said he had the greatest pleasure in moving the adoption of the report, although there was a little unpleasantness at the meeting. He did not wonder at it so far as Mr. Cawthra was concerned, and he thought that anyone who was treated so unkindly and ungraciously as was Mr. Cawthra could be excused for allowing his feelings to get the better of him. Councillor Bootiman seconded the motion. Councillor Sykes said he took it that the dignity of the Council must be paramount. The unpleasantness arose on the question as to whether Mr. Cawthra should have something in lieu of the holiday he had missed. While the position was being discussed, it was suggested that Mr. Cawthra should leave the room for the time being. He thereupon flew into a tantrum, snapped his fingers, turned up his lips in scorn, and said, "You can keep your testimonial, your money and your holiday." What he (Mr. Sykes) asked the Council to do that night was to "keep their testimonial." He moved that failing the receipt of a reasonable apology, the testimonial be not granted.

Councillor Dunlop seconded. Alderman Rennoldson said he would like to make one thing clear, and that was that Mr. Cawthra neither asked nor hinted at receiving any monetary compensation in lieu of his holiday. Mr. Cawthra wrote that he would like to have a little holiday before he went away. He (Alderman Rennoldson) told the Committee that he thought a holiday during the present month was out of the question, but it was for the Committee to say whether Mr. Cawthra should not have something in lieu thereof. What irritated Mr. Cawthra were the remarks of Mr. Dunlop, and he (the speaker) could excuse him. For any official to be humiliated in the way Mr. Cawthra was, was intolerable. On a division the Committee's report was adopted.

MR. G. F. NUTTALL has resigned his position of senior canvassing engineer to the Sheffield City Council, and, owing to this, a re-arrangement of the staff is to be made, MR. H. G. BENNETT, chief motor assistant, being appointed assistant superintendent of the wiring and fittings department at his present salary; MR. H. A. N. WHITE, second canvassing engineer, becoming first canvassing engineer, at £140 per annum, to be increased to £150 at the end of 12 months; and MR. F. K. SMITH, wiring and fittings clerk, being appointed second canvassing engineer, at £90 per annum, to be increased to £100 at the end of 12 months.

At a meeting of the Electricity and Tramways Committee of the Newport (Mon.) T.C. on Monday, the resignation of MR. H. COLLINGS BISHOP, general manager and electrical engineer, was received.

MR. P. H. BUZZA, senior assistant engineer at the Corporation electricity works at Colchester, has resigned. He has secured an appointment in the North of England.

MR. HARRY L. COTTAM, charge engineer at the Dewsbury Corporation electricity works, has been appointed charge engineer at the Colchester Corporation electricity works. There were 138 applicants.

MR. PERCIVAL SPIERS has resigned his position as chief assistant engineer to the Stratford-on-Avon Electricity Co., Ltd., in order to take up an appointment with the Hong Kong Electric Co.

Tramway Officials.—MR. JOHN FRASER, motor inspector in the employment of the Glasgow Corporation, has been recommended by the Kilmarnock Tramways Committee for the traffic managership of the Corporation tramways. Mr. Fraser has had 10 years' service in Glasgow.

General.—The *Daily Telegraph* says that MR. HENRY WALLIS has been appointed superintendent of the telephone department of the Central Post Office at Brighton in succession to Mr. F. Collins, who recently retired from the service.

In the list of Durbar Honours announced this week are the following:—

Henry Whitby Smith, Esq., Indo-European Telegraph Department, lately Director Persian Gulf Section, to be a C.I.E.

Ivor Cradock Thomas, Esq., Director Indian Telegraph Department, appointed M.V.O. (fourth class).

James Scott Pitkeathley, Esq., Electrical Inspector to the Government of the United Provinces of Agra and Oudh, and Electrical Engineer Delhi Coronation Durbar, appointed M.V.O. (fourth class).

To all these gentlemen we tender our hearty congratulations.

Obituary.—MR. E. H. TYLER.—The death occurred at Southampton on December 6th of Mr. Edward Henry Tyler, M.I.E.E.

MR. J. R. HANSON.—The death has occurred, from heart failure, of Mr John Robert Hanson, of Castle Street, Southport, who was in business in the town as an electrical engineer. He was only 33 years of age.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Jackson, McConnan & Temple, Ltd. (67,699).—A memorandum of satisfaction to the extent of £5,000 on March 28th, 1910, of debentures dated March 14th, 1901, securing £24,000, has been filed. Particulars of £20,000 debentures, created October 31st, 1911, filed pursuant to Sec. 93 (3) of the Companies' (Consolidation) Act, 1908, the amount of the present issue being £17,000. Property charged: The company's undertaking and property, present and future, including uncalled capital. No trustees.

Johnson & Phillips, Ltd. (84,968).—A memorandum of satisfaction in full on November 14th, 1911, of debentures registered June 15th, 1909, securing £50,000, has been filed.

Everett, Edgcumbe & Co., Ltd. (84,764).—A memorandum of satisfaction to the extent of £800 on September 1st, 1911, of debentures dated June 9th, 1905, securing £10,000, has been filed.

Foote & Milne, Ltd. (73,923).—Deed of charge on the company's undertaking and property, present and future, including uncalled capital, dated November 23rd, 1911, to secure £1,040. Holders: London County and Westminster Bank, Ltd., 41, Lothbury, and 21, Lombard Street, E.C.

Universal Light and Sign Co., Ltd. (115,336).—Issue on November 28th, 1911, of £185 debentures, part of a series of which particulars have already been filed.

Companie de Electricidad de la Provincia de Buenos Aires, Ltd. (117,118).—Particulars of £900,000 debentures, created November 6th, and secured by trust deed dated November 24th, 1911, filed pursuant to Sec. 93 (3) of the Companies' (Consolidation) Act, 1908, the whole amount being now issued. Property charged: The company's undertaking and property, present and future, including uncalled capital, power distributing and transforming stations in Argentine Republic, and all existing and future concessions and contracts relating to the supply of electricity. Trustees: City Safe Deposit and Agency Co., Ltd.

CITY NOTES.

British Electric Traction Co., Ltd.

MR. E. GARCKE presided on December 7th at the offices, 1, Kingsway, W.C., over an extraordinary general meeting of this company for the purpose of considering and, if thought fit, confirming the resolution recently passed for rearranging the capital of the company.

The CHAIRMAN said that, in view of the full discussion which had taken place on the scheme of arrangement, they would not wish him to say anything further in support of the resolution which he would content himself with moving. On the motion being confirmed, the scheme of arrangement would be complete except for the formal issue of the new stock certificates in place of the existing certificates, in regard to which notice would be issued to the shareholders.

MR. RAWORTH seconded the resolution, and it was adopted without discussion.

MR. WARD asked if it was a fact, as stated in the Press, that the company contemplated promoting a motor-bus company in opposition to the London General Omnibus Co. As a considerable shareholder in the company and a former shareholder in the Omnibus Co., he would like to know if there was any truth in the statement.

The CHAIRMAN: I may say at once it would be exceedingly inconvenient to discuss questions of policy of that kind at this stage. The statement to which you have referred is not entirely incorrect, but it certainly is quite premature, and it is impossible for me to make any public statement with regard to the matter at present.

Prospectuses.—*Compania de Electricidad de la Provincia de Buenos Ayres, Ltd.*—On Tuesday last the list was to close in an issue of £750,000 5 per cent. first mortgage gold bonds to bearer in bonds of £20 each, at the price of 95 per cent., or £19 per bond. The issue was made by the Credit Mobilier Francais through the London and Brazilian Bank, Ltd. The nominal capital of the company is £1,000,000 in 250,000 shares of £4 each. The business of the company is stated to be steadily increasing, and the working capital which will be provided by the present issue will enable further extensions to be made. The company acquired the undertakings and assets of another company of the same name (the Argentine company). In the suburbs of Buenos Ayres current is obtained in bulk from the Companis Alemana Transatlantica under contracts having an average period of about 26 years to run, and is distributed through the company's own substations. Under these contracts the Argentine Co. has the exclusive right from the Compania Alemana Transatlantica of supplying and distributing electric current in the following suburbs of Buenos Ayres, viz., Lomas, Temperley, Banfield, Adrogue, Quilmes, Bernal, Burzaco, Ballester, Hue and Klein. The Argentine Co. have their own generating stations in the following towns, viz., Tres Arroyos, San Nicolas, Pergamino, San Pedro, Azul, Junin, Mar del Plata and San Martin in the province of Buenos Ayres, and in San Luis, the capital of the province of the same name. The Argentine Co. is also the owner of several concessions for public lighting granted by the various municipalities in the towns served. The profits of the Argentine Co. for the past three years have been £27,485, £29,696 and £54,060, before charging interest, depreciation and administration. It is estimated that for 1911 they will be £80,000.

Mexican Fuel and Power Co., Ltd.—The list closed on 9th inst., in an issue of 50,000 7 per cent. £1 cumulative participating preference shares at par.

Eastern Extension, &c., Telegraph Co., Ltd.—The directors have declared an interim dividend for the quarter ended September 30th last of 2s. 6d. per share free of income-tax.

Stock Exchange Notices.—The Committee have appointed a special settling day as under:—

Wednesday, December 20th.—Manaos Tramways and Light Co., Ltd.—300,000 ordinary shares of £1 each, fully paid (Nos. 1 to 300,000).

And ordered the undermentioned to be quoted in the Official List:—

Consolidated Gas, Electric Light and Power Co., of Baltimore.—$1,000,000 general mortgage 4½ per cent. 30-year gold bonds of $1,000 each (Nos. 11,565 to 12,564).

United Electric Tramways of Monte Video, Ltd.—The directors have announced an interim dividend of 3s. per share, less tax, on the ordinary shares.

Western Telegraph Co., Ltd.—The directors have declared the first quarterly interim dividend of 3s. per share, free of income-tax, for the year ending June 30th, 1912, being at the rate of 6 per cent. per annum. The transfer books will be closed from December 14th to 20th inclusive.

Calcutta Electric Supply Corporation, Ltd.—The number of units delivered to consumers during the four weeks ended October 27th, 1911, were 916,552, compared with 736,085 units in the corresponding four weeks of 1910.

India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.

In the directors' report for the year ended September 30th, 1911, it is stated that the accounts show, after provision for doubtful debts, a net loss of £55,457. Transferring £50,000 from the reserve fund, adding £22,614 brought forward, and deducting £9,375, the dividend on the preference shares paid in January and July, there remains, after providing for the preference dividend accrued to September 30th, a balance of £4,657 which the directors propose to carry forward. The directors recommend that the payment of the half-yearly dividend of 5s. per share or at the rate of 5 per cent. per annum be made to the preference shareholders on January 1st prox., but find themselves unable to recommend any distribution of a dividend to the holders of ordinary shares. The general business of the company has been fully maintained, but it has unfortunately been absolutely impossible during the last 18 months to vary the selling prices in step with the enormous fluctuations in the costs of raw material, both in the form of stock and purchases. The effect has been exceptionally severe in the case of the French works. A diagram clearly demonstrating the fluctuations referred to is circulated with the report. Taken as a whole our foreign agencies have done a fairly profitable business. The electrical industry shows a slight improvement. The volume of the submarine cable work is much the same as last year, and the steamers *Dacia* and *Buccaneer* have had fair employment. The works at Silvertown and Persan have been maintained in the usual state of efficiency. Mr. C. H. Moore, the retiring director, offers himself for re-election.

The general meeting will be held at 106, Cannon Street, E.C., on Tuesday, December 19th, at 12 o'clock noon.

The diagram which accompanies the report is the Para Market Chart issued by the *India Rubber Journal*, showing the violent fluctuations in prices of rubber in 1910 and 1911. The price of fine hard Para which, in January, 1911, was 5s. 1½d. per lb., rose by the beginning of March to 7s. 1d., dropping gradually to as low as 3s. 10d. early in June, rising to 5s. 0½d. in September, since when it has gone down to 4s. 4d. The 1910 chart shows the following fluctuations:—January, 7s. 7d.; April, 12s. 8½d.; June, 8s. 9d.; October, 6s. 2½d.; December, 5s. 5d

We have brought together below the figures given in the accounts for this year and last:—

Year ended—Sept., 1910.	September, 1911.
Brought forward, £55,012	£22,614
Net profit, £55,414	Net loss, £55,457
Ordinary dividend—10 per cent. £12,500 interim £37,500 final	Nil
Put to reserve against stocks—£30,000	Taken from reserve, £50,000. The preference dividend is to be paid and £4,657 carried forward.

Profit and Loss Account.

	Sept., 1910.	Sept., 1911.
Salaries, commission, rent and general expenses	£72,534	£79,001
Mortgage deben. interest ...	16,000	16,000
Bad debts	1,122	1,245
Income-tax	1,790	2,478
Depreciation, buildings and machinery	24,892	24,977
Directors' remuneration ...	2,400	2,400
Gross profit after making provision for doubtful debts, &c.	180,619	64,178
Balance	Profit 55,414	Loss 55,457

"The prices of some raw materials attained an abnormally high level, but the advances the company were able to make in selling prices . . . . have, except in the case of the French works, sufficiently met the situation. The stocks, however, are highly priced, and the board have thought it desirable to make the provision mentioned above."—*Directors' report issued December*, 1910.

"It has, unfortunately, been absolutely impossible during the last 18 months to vary the selling prices in step with the enormous fluctuations in the costs of raw material, both in the form of stock and purchases. The effect has been exceptionally severe in the case of the French works."—*Directors' report issued December*, 1911.

Melbourne Electric Supply Co., Ltd.

The directors' report for the year ended August 31st, 1911, states that in view of the increasing capital requirements of the Melbourne and Geelong undertakings, an extraordinary general meeting in July adopted a resolution raising the unexercised borrowing powers from £150,000 to £250,000. In pursuance of these powers, the directors have created £250,000 second debenture stock, which they propose to issue as and when required, and of which £100,000 has been lodged with the company's bankers as collateral security for a temporary loan. Since the close of the financial year the directors have sold and allotted the unissued balance of 10,000 7 per cent. first cumulative preference shares at a price equal to par net to the company; and they have also sold a further 4,475 Adelaide ordinary shares at a substantial profit. During the year capital expenditure in Australia on additional land, buildings, plant, mains, &c., has been incurred as follows:—On the Melbourne undertaking, £69,015; Geelong, £8,891; Geelong tramways, £24,243 = £102,149.

The profit and loss account shows that the gross profit derived during the year from the Melbourne and Geelong undertakings was £36,433. Adding the dividend received on the company's holding of ordinary shares in the Adelaide Electric Supply Co., Ltd., together with discounts, transfer fees, &c., the total gross profit for the year amounts to £46,334.

After payment of management and general expenses at the London head office, and interest on debenture stock and temporary loans, and after making the following allocations, viz.:—To extinguish suspense account, £5,861; to depreciation and general reserve account, £7,000; to writing down head office furniture, £50; there remains a credit balance of £16,675, to which must be added £3,353 brought forward, making a total credit balance of £20,028. Deducting from this sum the dividend on the 7 per cent. first cumulative preference shares for the half-year ended February 28th, 1911, there remains an available balance of £16,528, which the directors recommend should be applied as follows:—

Dividend on 20,000 7 per cent. first cumulative preference shares to August 31st, 1911 (paid on September 1st, 1911), £3,500; dividend on 2½ per cent. on £174,170 consolidated ordinary stock, free of income-tax, £4,354; debenture stock sinking fund, being the proportion accrued from January 1st to August 31st, 1911, of the annual amount of £2,500, £1,667; income certificate service fund, £1,800; leaving to carry forward, £5,207.

The directors recommend the setting aside of the full amount of the annual income certificate service fund of £1,800, and the application of such sum first in the payment of 3 per cent. interest on, and the balance towards the redemption of, the outstanding certificates.

The Melbourne undertaking has shown satisfactory growth during the past year; the total connections having increased by 41 per cent., the total units sold by 50 per cent., and the gross profit by 72 per cent., as compared with the previous year.

The negotiations with the Town Council of Hawthorn, an important suburb of Melbourne, for a lease of their Order-in-Council have recently been concluded, the order has been transferred to the company, and mains are now being laid in the district.

The construction of the small system of electric tramways at Geelong has been steadily proceeded with during the year; and it is expected that the lines will be opened for traffic in the course of next month.

The following tables show the progress made by the Melbourne and Geelong undertakings during the past four years:—

	Lighting in 30-watt lamps.	Motors in rated H.P.	Total equiv. connections in 30-watt lamps.	Total units sold.	Gross profit.
Melbourne.					
August 31, 1908..	90,088	2,150 H.P.	167,412	2,326,307	£16,053
August 31, 1909..	104,900	2,434 H.P.	182,788	2,716,174	£20,578
August 31, 1910..	136,562	3,688 H.P.	252,588	3,394,525	£19,279
August 31, 1911..	189,324	5,196 H.P.	355,596	5,0[illegible]9,162	£33,2[illegible]6
Geelong.					
August 31, 1908..	26,942	818 H.P.	51,864	312,661	£1,623
August 31, 1909..	28,336	898 H.P.	56,920	364,770	£2,439
August 31, 1910..	33,756	994 H.P.	63,938	413,101	£2,022
August 31, 1911..	37,938	1,133 H.P.	74,186	506,267	£3,206

Further illustration of the increasing development of the Melbourne business is afforded by some graphic curves which accompany the report.

The Adelaide Electric Supply Co., Ltd., has continued to make good progress during the year; and a dividend of 10 per cent. on the ordinary shares, together with a bonus of 2s. per share, has been paid in respect of the year ended August 31st, 1911, credit for which has been taken in this company's profit and loss account.

Isle of Thanet Electric Tramways and Lighting Co., Ltd.

Lord Arthur Butler (Chairman) presided at Winchester House, E.C., on December 7th, over the ordinary general meeting of this company.

In moving the adoption of the report, the Chairman said they were presenting a statement of accounts which they considered very satisfactory. The gross revenue showed an increase of £4,628. The traffic receipts increased by the very satisfactory figure of £2,817. The weather of 1910 was very unfavourable for traffic, but that of 1911 had been all that they could desire from a traffic point of view. The electric lighting had again shown a large increase, viz., £1,784, or over 32 per cent., a very gratifying rate of expansion which promised to continue. Turning to the expenditure side of the revenue account, the figures bore favourable comparison with the corresponding items of last year's account. Coal and coke showed an increase of £813, owing to the larger output of electric current, the units generated being 2,120,791 this year, against 1,790,923 last year, an increase of nearly 18 per cent.; and to a scarcity and higher price of coke, of which they used all they could get from the local gasworks. The scarcity of coke had involved the use of a larger quantity of the more costly coal. They had a balance being profit of £21,785 against £18,242, an increase of no less than £3,542, which was nearly 80 per cent. of the increase in gross receipts, viz., £4,628, so that it cost them only £1,086, or little more than 20 per cent. of the increase to earn the additional profit. The improvement in the net earnings of the company had been steady and continuous in recent years. During the last four years he found that the profits earned by the business were:—In 1908, £13,390; in 1909, £15,053; in 1910, £18,242; and in 1911, £21,785, which was very satisfactory progress. The profit for the past year was carried down to the appropriation account, and after debiting the debenture interest and interest on loans, income-tax, &c., the amount of net profit transferred to the revenue account in the balance-sheet was £13,255 against £9,550, an increase of £3,705. If they turned to the balance-sheet they would see on the debit side

that their loans were £42,000 against £44,000, a decrease of £2,000, which had been paid off in the year; the creditors were £3,868 against £1,909, an increase of £1,959, and this increase represented the sum due to the contractors for the supply of additional machinery. The item "contractor for unpaid balance" was £1,000 against £1,750 last year, a reduction of £750, being the amount they had paid Mr. Murphy in the year. Then the reserve account had been increased from £8,500 to £11,000, the permanent way reserve from £1,500 to £4,000, the increase in each case of £2,500, being the amounts set aside to these purposes out of last year's revenue balance. On the credit side of the balance sheet there was considerable alteration in the figures. They had had to provide, in order to meet their growing business, a new high-tension cable (£3,541), additional plant and machinery (£2,077), and they had had to spend on electric light installation £2,705. All these sums had been paid with the exception of the balance due to contractors, about £2,300, which would be paid in due course. In electric lighting, as in gas undertakings, the expenditure on capital account never ceased as long as the business continued to grow. They could not secure new customers without sufficient cable and generating capacity to supply them, and they had to face, in the immediate future, the provision of an additional generator at their power house in anticipation of the increased load which they expected next autumn. No money could, however, be better invested than capital expenditure to meet a growing demand for electric current when it could be sold at a reasonable price. The final result was that they had at the credit of revenue account in the balance-sheet £15,532 against £11,026 last year, and their recommendation was that they should pay the preference shareholders half their year's dividend, £3,750, place £1,500 to reserve account, place £6,000 towards future maintenance of permanent way, raising that fund to £10,000 for special maintenance expenditure or reconstruction of line when the time came, and they proposed to start a new reserve for third-party insurance with £2,000, and carry forward to next year £2,282, against £2,276 brought into the account. With reference to the appropriation of £2,000 to a third party insurance reserve, he might explain that it was becoming increasingly difficult not only for them, but for other tramway companies, to place their third party risks with solvent insurance companies on reasonable terms. As long as they could get covered at reasonable rates, they proposed to continue insuring, but in case they should find it advisable to take the risks themselves, they could do so with much more confidence if they had a reserve specially earmarked for the purpose of meeting any exceptional claims. With regard to the other appropriations, £1,500 was not a large amount to put to general reserve, and though £6,000 might seem a large sum to place to renewal of permanent way, they were warned, by the experience of the older electric tramway companies, that this became a very heavy charge, after a certain period in the life of the rails and paving. With this survey of the figures, he would anticipate that some preference shareholder might say with all this prosperity, "Why don't you pay us a larger dividend?" Well, the reply to that was that although the financial position of the company had been immensely improved during the past four or five years, they were unable to pay shareholders their full dividend without borrowing. They could pay the 2½ per cent. out of their cash resources, but if they gave anything more than that, they should have to borrow, and that they were anxious to avoid. They looked forward, however, to the time when they would be able to increase the distribution. In conclusion, the chairman said he would like to express their appreciation of their manager, Mr. Forde, for his work and energy during a very arduous summer season, and also for the ability and care with which he had dealt not only with the traffic, but also with the electric lighting part of the business.

Mr. A. R. Monks seconded the motion.

Mr. P. Sharp said he agreed with conservatism in business, but £6,000 was a large sum to set aside for the maintenance of the permanent way, and he would like to know if there was any special reason for putting away such a large sum.

Mr. Lea Smith said he took it that the speaker had not been over the permanent way.

Mr. Sharp: I have never seen it.

Mr. Lea Smith: "Ah!" He considered it was the wisest thing the directors could possibly have done to set aside this sum of money. No doubt the past summer had been a good one, except that, in his opinion, it was too hot for the traffic. He motored several times to Margate, and generally found the whole of the population in the water.

Mr. Holman asked for a further explanation of the sum set aside for third-party risks.

Mr. Trubshaw pointed out that nothing was allowed for depreciation, and seeing that there must be a great deal of wear and tear on the tramways, asked the reason for this omission.

The Chairman explained that they had set aside £10,000 for the permanent way, and their general reserve would now stand at £12,500, and this was really the same thing as a depreciation fund. In fact, the auditors qualified their remarks by referring to the general reserve.

Mr. Sharp asked if it was the intention to allow the permanent way to get into a worse condition and then take it in hand.

Mr. W. M. Murphy explained that the ordinary maintenance for the year included such things as a renewal of points and crossings, the packing up of rails, and the application of various remedies for prolonging the life of the rails. Eventually, however, the time came when the rail became dead and had to be replaced, and it was for that that such a fund was required. They would not have to replace the rails for some years, and they hoped the provisions they would be able to make would be amply sufficient. With regard to third-party risks, they found it difficult to place such risks with the insurance companies except at unreasonable premiums, and in another company with which he was connected, they did form a small fund, which came in very fortunately when one of the insurance companies in which they were insured went into liquidation. It was to meet these peculiar and uncertain claims which were made on tramway companies that they proposed to establish this fund, which he did not think need exceed £5,000 or £6,000.

Mr. Lock, as a former critic of the board, complimented them on the improved state of affairs.

The report was then adopted, and the retiring directors and auditors were re-elected

---

Power-Gas Corporation, Ltd.—The directors' report for the year to September 30th last states that the results of the year's trading of Ashmore, Benson, Pease & Co., Ltd., show a total profit of £14,257, plus the balance brought forward, £2,352, making £16,609. Of this £4,000 has been transferred to reserve, £9,000 to the accounts of the Power-Gas Corporation, Ltd., for dividend, and the balance, £3,609, carried forward. The results of the year's trading of the Corporation show a total profit of £13,906, plus £2,122 brought forward, making £16,029, which the directors propose to apply as follows:—To reserve fund, £2,780; to dividend at 4 per cent. per annum upon the ordinary shares, £9,984: balance to be carried forward, £3,264.

Manx Electric Railway Co.—The directors' report for the year ended September 30th, 1911, states that the gross receipts amounted to £36,013, and the gross expenditure to £17,214, leaving a balance of £18,799, making, with balance forward, a total of £19,036. Debenture interest has absorbed £9,000, and the interim dividend of 2¾ per cent. on the preference shares, £3,580, leaving a balance of £6,455. Out of this it is proposed to pay the balance of preference dividend due in respect of the year, £3,580, and to reserve for special renewals £1,500, leaving £1,375 to be carried forward. There has been no capital expenditure during the year. Passenger receipts increased by £3,255; and goods and other receipts by £176, making a total increase of £3,431. The working expenses amount to £17,214, which is nearly £100 less than last year. The ratio of working expenses to receipts was 47·78 per cent. in 1911, as compared with 53·12 per cent. in 1910.

British Electromobile Co., Ltd.—The directors' report, says the *Financier*, shows a profit of £1,800 on the past 18 months, and the deficit is turned into a small surplus, besides providing for depreciation and for debenture interest and creating a reserve.

United River Plate Telephone Co., Ltd.—The directors have declared an interim dividend of 3 per cent. on the ordinary share capital, free of income-tax, for the half-year ending September 30th.

Douglas Electric Tramways, Ltd.—At the sixteenth annual meeting held in Manchester last week, it was reported that the receipts were £5,644, against £4,812. Passengers carried numbered 230,653, an increase of 34,565. Net profit was £2,125, against £1,482. The directors recommended a dividend at the rate of 7 per cent. on the preference shares, and 1½ per cent. on the ordinary shares, leaving £301 to carry forward.

Consolidated Gas, Electric Light and Power Co. of Baltimore.—The directors have declared a dividend of 1¼ per cent., being at the rate of 5 per cent. per annum on the Common shares for the quarter ending December 31st.

Manila Electric Railroad and Lighting Corporation, Ltd.—The directors announce that a dividend of 1½ per cent. for the quarter ending December 30th has been declared on the capital stock, being an increase of ¼ per cent. on the previous quarterly payment. According to the *Financial News*, the Corporation's financial year ends on December 31st, and the following figures show the results for the 11 months:—Gross earnings, $1,325,500; same period last year, $1,183,692; increase, $141,808. Net earnings, $697,100; same period last year, $598,403; increase, $98,697.

STOCKS AND SHARES.

Tuesday Evening.

The Stock Exchange is finishing up the year in a state of mind of subdued cheerfulness. The Railway outlook has become much more promising, with the result that prices moved up swiftly. Amongst Industrials, a forward movement in rubber is an outstanding feature. The elevation in Foreign Electrical issues shows no sign of slackening. Business is still described as patchy, but it is certainly on a broader basis, and it looks as though prices will end the year with a good deal of firmness.

Consols and their satellites were unfavourably affected by the idea that a fairly substantial issue will be required in the New Year for the purchase of the National Telephone Company's undertaking; but, on the motion in the House of Commons for making a payment on account, the price of the premier security recovered. National Telephone stocks themselves are, comparatively speaking, quiet, and the Deferred has slipped back a couple of points. Further discussion has arisen with regard to the actual position of the company's 3½ per cent. Debenture stock and the point as to

whether it is entitled to be paid off at 103 or not. The current quotation of par, middle, reflects the market view of the possible outcome.

English Electricity Supply descriptions keep steady on the whole, but there is no feature calling for particular mention. The Joint Conference of London Electric Supply Authorities which sat last week had no influence upon the market, so far as prices were concerned, although the proceedings evoked satisfaction. St. James' are a little easier at 8 middle, and London Electric Ordinary fell 5s. On the other hand, South Metropolitan Preference picked up $\frac{1}{32}$ after its decline of last week, and several of the Debenture stocks advanced, the principal rise being secured by Kensington and Knightsbridge stock, a small inquiry for which sufficed to raise the price 3 points to 95 middle.

The Home Railway market, as already noticed, gained very substantially on the idea that the recent conferences between masters and men will make for eventual peace. Prophets, moreover, ventured upon the forecast that the men's ballot would show a big majority against a general strike. Upon this, prices of steam stocks rose materially, and those of the Tube lines participated in the improvement. Metropolitan Ordinary went up 1½. Districts continued to go ahead, and the price hardened to 31½ upon the latest acceleration of the company's already rapid service. All the same, the trains continue to be uncomfortably crowded during rush hours, and conductors have been overheard to grumble numerously that they are now expected to think in seconds instead of in minutes in consequence of the alteration of the time-tables. Central Londons have not moved.

British Electric Traction shares are unchanged, but the 5 per cent. Debenture shows a loss of 1 on the highly-interesting rumour that the company—perhaps in consort with some other undertaking—contemplates an excursion into the motor-omnibus business of the metropolis. The holders of London General Omnibus stock are not greatly perturbed by this prospect is evidenced by the fact that the latter company's stock continues to rise merrily. It is worth noticing that Potteries 4½ per cent. Debenture show a rise of 3½ points on the week. The Preference shares, however, are $\frac{1}{32}$ easier. Underground Electric Railways issues hold their improvements, and there is big business being done daily in the company's 6 per cent. Income bonds on the basis of 68 middle. The restless energy of the group inspires confidence amongst stockholders of the various classes of securities connected with the concern, and District stocks are being bought again as speculative investments. Metropolitan Electric Trams 4½ per cent. Debenture stock is 1½ higher at 103; though, on the other hand, London United Tramways 4 per cent. Debenture at 72 is down on the week.

New issues have not been going any too happily for the underwriters during the past few days. It is, therefore, all the more noticeable that the premium on the new South American Light and Power Debentures should have risen 2¾. On Tuesday £750,000 5 per cent. First Mortgage Gold Bonds of £20 each were offered by the Compagnia de Electricidad de la Provincia de Buenos Ayres, at 95 per cent. In spite of the fact that 20 per cent. was payable on application, and 75 per cent. becomes due a month hence, the bonds, it is reported, were rapidly subscribed, and a premium of ½ established in the market. The bonds appealed, of course, principally to Paris, and the issue, some said, was covered in that city even before they were offered here. There was no underwriting. The Puebla Tramway issue was left in the hands of underwriters to the extent of 64 per cent., and the scrip is quoted at a discount of about 1½.

Nevertheless, the group as a whole maintains its prices with considerable strength, having regard to the number of fresh applicants with inviting offers. Montreal Light, Heat and Power rose no less than 6 points, and the shares now stand at a premium of 93½ per cent. Shawinigan gained ½, Melbourne Debenture 2, and Cordova Light Debenture 1. Manaos First Debenture put on 1½, and various other bonds of this group strengthened ½ to 1½. The report of the Melbourne Electric Supply Company shows a dividend of 2½ per cent. on the Ordinary, which is about one-third of what was earned. This explains the remarkable rise which has taken place in the stock this year, and the 5 per cent. bonds themselves are 2 higher at 101. The Mexican shares and bonds are a trifle irregular, movements amounting to very little on balance. Rio shares reacted ½, but the bonds are better.

In the Telegraph market investors are buying Eastern Ordinary and Eastern Extension shares on the yields obtainable from securities that keep so steady as these two do, and, as a consequence, the prices of both show slight improvements. The feature, however, continues to be the very lively dealings in Marconi shares, which forced the price up at one time to 5¼s. 6d. There is, in Stock Exchange parlance, a big account open for the rise, and it might not take very much bad news to bring about a smart relapse. The Preference shares at 2 are a shade easier. West India and Panama, which appear to be an excellent speculative investment of their class, braced up to 2½, with a good many cheap buyers about. Anglo-American Preferred has been sold, but the Ordinary at 67½ is ½ higher. American Telephone and Telegraph lost a point at 143. The bond market is firm, with more buyers than sellers for the soundest varieties.

For the India-Rubber, Gutta-Percha and Telegraph Works Company to pass its ordinary dividend altogether, after paying 10 per cent. regularly since 1904, caused something of a sensation in the market. Both Ordinary and Preference fell heavily. The tremendous fluctuations in the price of the raw stuff are responsible for the company's loss of £55,000 for the year just ended. Rubber goes on rising day by day, and the fortnightly sales at Mincing Lane this week have shown good prices. Telegraph Constructions are 10s. up. Edison & Swan again rose $\frac{1}{8}$, and Electric Constructions of both classes are a good market at advanced prices.

ELECTRIC TRAMWAY AND RAILWAY TRAFFIC RETURNS.

Locality.	Fortnight ended.	Receipts for the fortnight.		No. of wks.	Total to date.		Route miles open.	Inc.
		£	£*		£	£*		
Aberdeen	Dec. 6	2,723	+ 84	27	41,592	+ 2,277	..	..
Ayr	„ 9	374	+ 29	30	10,419	+ 89	8	..
†Bath	Nov. 25	649	+ 16	48	40,218	+ 1,243	..	..
Birkenhead	Dec. 10	2,231	+ 58	36	41,690	+ 1,475	18·7	..
Birmingham Corp.	„ 2	18,565	+4,710	35	298,542	+58,489	56·4	..
†Blackburn	„ 6	1,001	+ 52	36½	42,818	+ 3,623	14·6	..
Blackpool Corp.	„ 7	861	+ 127	..	56,938	+ 7,862	..	..
Blackpool-Fleetw'd	„ 9	480	+ 44	23	25,020	+ 2,072	..	..
†Bolton	„ 2	2,412	+ 172	36	90,575	+ 6,040	26	..
Bournemouth	„ 6	2,729	+ 105	36	66,716	— 356	22	..
Bradford	„ 2	9,883	+ 657	35	195,0·2	+18,433	56	1·2
Brighton	„ 10	1,503	+ 49	36½	39,421	+ 2,259	9·5	..
Bristol	„ 8	11,559	+ 503	..	..	..	..	..
Brit. Elec. Trac. Co.								
Airdrie	Dec. 1	534	+ 122	48	10,895	+ 424	3·65	..
Barnsley	„ 1	354	+ 28	„	8,9·8	+ 662	..	..
Barrow	„ 1	559	+ 138	„	14,950	+ 2,146	5·37	..
Devonport	„ 1	917	+ 132	„	23,982	+ 3,561	8·65	..
Gateshead	„ 1	2,064	+ 143	„	50,2·5	+ 2,7·8	11·25	..
Gravesend	„ 1	378	— 2	„	10,277	+ 861	6·5	..
Greenock	„ 1	1,340	+ 446	„	34,879	+ 5,604	7·25	..
Hartlepool	„ 1	505	+ 125	„	13,149	+ 1,359	6·72	..
Kidderminster	„ 1	178	+ 5	„	5,612	+ 814	..	..
‡Leamington	„ 1	304	+ 45	„	8,561	+ 433	..	..
Merthyr	„ 1	187	+ 37	„	10,058	+ 193	2·9	..
Metropolitan	„ 1	15,886	+2,555	„	422,2·3	+63,555	22	..
Middleton	„ 1	585	+ 52	„	16,380	+ 1,803	8·5	..
Mid. Joint Com'tee	„ 1	8,227	—3,005	„	211,414	—27,080	..	..
Oldham—Ashton	„ 1	1,090	+ 78	„	27,686	+ 1,216	9·19	..
Peterborough	„ 1	211	+ 21	„	6,186	+ 624	5·21	..
Potteries	„ 1	4,112	+ 327	„	94,424	+ 8,688	29	..
Rothesay	„ 1	76	+ 2	„	10,033	+ 59	2·75	..
Southport	„ 1	45·	+ 18	„	14,593	+ 566	8·17	..
S. Metropolitan	„ 1	1,209	+ 70	„	41,388	+ 2,165	..	..
Swansea	„ 1	2,1·6	+ 197	„	55,0·4	+ 3,252	12·5	..
Tynemouth	„ 1	279	+ 16	„	12,561	+ 404	3·76	..
Weston-s-Mare	„ 1	49	+ 2	„	8,138	+ 1,054	2	..
‡Worcester	„ 1	463	— 1	„	14,200	+ 629	5·75	..
Wrexham	„ 1	204	+ 32	„	4,930	+ 288	..	..
Yorks. Wool. Dist.	„ 1	1,9·0	+ 186	„	50,764	+ 3,411	17	..
Miscellaneous	„ 1	576	+ 43	„	10,895	+ 712	..	..
Burnley	„ 9	2,648	+ 233	..	..	..	11·73	..
Burton-on-Trent	„ 10	508	— 43	36	10,566	+ 572	6·6	..
Bury	„ 10	2,251	+ 88	36	47,085	+ 3,975	22·5	..
Cardiff	„ 9	4,453	+ 31	36	89,609	+ 6,656	..	..
Chatham and Dist.	„ 7	1,484	— 81	49	41,780	— 19	15	..
Cork	„ 7	867	+ 1	49	24,433	+ 563	9·9	..
Croydon	„ 1	2,991	+ 210	35	64,048	+ 4,651	11·4	..
Darlington	„ 25	448	+ 56	35	7,788	+ 746	..	..
Darwen	„ 8	489	+ 2	36	9,759	+ 709	4·36	..
Dover	„ 2	858	+ 16	35	9,466	+ 1,347	4·75	..
†Dublin	„ 1	5,173	+ 287	..	136,799	+11,537	54·2	..
Dundee	„ 22	2,212	+ 57	27	52,513	— 760	15	..
East Ham	„ 9	2,088	+ 198	36	39,904	+ 2,169	7·87	1
Exeter	„ 8	530	— 19	36	12,698	+ 842	5·5	..
Glasgow	„ 9	37,881	+3,054	..	527,227	+37,991	98	..
Hastings	„ 7	1,372	+ 22	..	..	+ 666	..	..
†Huddersfield	„ 2	1,875	+ 148	35	67,911	+ 7,123	29·5	1
Hull	„ 9	5,968	+ 213	36	105,453	+ 5,616	14·5	..
Ilkeston	„ 7	222	— 4	36	4,811	+ 88	..	..
Ipswich	„ 10	667	— 27	36	16,491	+ 892	10·5	..
Kilmarnock	„ 9	300	+ 21	30	4,996	+ 399	4·25	..
Lancashire United	„ 6	2,464	+ 199	49	66,·66	+ 2,468	89	..
Leeds	„ 2	14,117	+ 921	35	256,996	+18,679	50·75	2
Leicester	„ 9	4,·28	+ 218	..	..	..	..	..
†Leith	„ 2	582	+ 72	28½	19,345	+ 1,457	8·7	..
Liverpool	„ 2	29,180	+1,0·6	48	549,847	+17,836	116	3·5
†L.C.C.	Nov. 29	82,997	+5,908	..	1,539,245	+84,276	140	6
London United	Dec. 9	10,665	+ 776	..	317,706	+11,636	..	..
Lowestoft	„ 9	301	— 21	10	1,779	+ 13	3·5	..
Manchester	„ 9	31,535	+1,652	36	589,781	+32,208	188	..
Newcastle	„ 9	8,402	+ 780	..	155,7·9	+12,099	14·5	..
†Newport	„ 2	665	+ 27	35	25,127	+ 991	14·5	..
Oldham	„ 10	3,681	+ 154	37	72,0·5	+ 3,263	28·75	·5
Pontypridd	„ 9	725	— 5	36	15,109	+ 9	5·5	..
†Portsmouth	„ 2	1,617	+ 16	35	81,697	+ 6,708	15·25	..
Preston	„ 6	1,4·9	— 40	36	28,543	+ 2,059	..	..
Rotherham	„ 7	1,330	+ 113	31½	24,771	+ 2,025	12	..
Salford	„ 4	9,702	+ 681	35	174,205	+ 8,0·4	..	..
Sheffield	„ 12	12,996	+ 726	37	238,962	+16,849	40	..
Southampton	„ 6	2,135	+ 96	36	45,327	+ 5,507	22	..
Southend-on-Sea	„ 6	8·8	+ 142	36	26,486	+ 4,012	..	..
†South Shields	„ 2	566	+ 84	31	22,37·	+ 2,434	..	..
Swindon	„ 6	283	+ 22	..	5,884	+ 636	..	..
Tyneside	„ 6	854	+ 206	28	11,7·0	+ 1,926	..	..
Wallasey	„ 9	1,951	+ 147	36½	40,673	+ 5,584	..	..
Walthamstow	„ 9	1,961	+ 64	36	27,7·1	+ 1,7·4	9	..
West Ham	Nov. 30	5,144	+ 648	35	95,925	+ 8,947	15·25	..
Wolverhampton	Dec. 6	1,837	— 7	36	35,738	+ 2,0·0	25	..
Cen. London Rly.	„ 9	10,739	— 571	23	109,194	—16,166	6·32	..
City & S. Lon. Rly.	„ 10	5,979	— 255	24	78,128	— 428	7·26	..
Dublin-Lucan Rly.	„ 8	216	+ 11	24	3,4·6	— 40	7	..
G.N. and City Rly.	„ 12	3,425	+ 358	23	33,472	+ 1,017	3·5	..
L'pool Overh'd Rly.	„ 10	2,842	+ 202	..	34,483	+ 2,008	6·3	4·3
Llandudno-Col. Bay	„ 8	231	+ 33	..	..	..	..	..
London Elec. Ry. Co.	„ 9	29,4·0	+1,170	23	296,795	+10,195	21·25	..
Mersey Railway	„ 9	4,3·1	+ 141	23	44,748	— 1,073	4·5	..
Metropolitan Rly.	„ 10	37,2·8	+ 341	23	385,·72	— 4,549	24·5	..
Met. District Rly.	„ 9	24,065	+ 885	23	257,634	+11,454	24	..
Anglo-Argentine	„ 9	10·,491	+2,784	..	2,402,·88	+196,950	..	..
‡Auckland	Nov.	16,594	+1,168	20	81,451	+ 6,196	23·3	·6
Bombay (B.E.T.)	Nov. 10	5,695	+ 118	45	190,982	+ 8,337	..	..
‡Brisbane	Nov.	21,890	+3,1·0	48	227,870	+27,460	..	..
Brit. Columbia Rly.	..	..	..	..	..	..	..	..
Calcutta	Dec. 9	7,720	+ 813	..	..	..	..	..
Cape Electric T.Ld.	..	..	..	..	..	..	..	..
‖Kalgoorlie, W.A.	Nov.	3,165	..	48	37,944	..	20·5	..
‖Lisbon	..	..	..	..	..	..	..	..
Madras	Nov. 15	1,491	+ 118	..	31,067	+ 2,688	..	..
‖Montevideo	Nov.	25,614	+2 523	..	..	..	..	..
Perth (W.A.)	Dec. 8	3,444	+ 501	49	79,803	+16,947	29	..

* Compared with the corresponding period of 1910. † One week only.
‡ Includes horse, steam and other receipts. ‖ One month.

SHARE LIST OF ELECTRICAL COMPANIES.

ENGLISH ELECTRICITY SUPPLY AND POWER COMPANIES.

NAME.	Stock or Share.	Dividends for		Closing Quotations Dec. 12th.	Rise + or Fall —	Present Yield p.c.
	*	1910.	1911.			£ s. d.
Bournemouth & Poole, Ord.	10	5½	5†	7⅞ — 8⅜	..	6 5 9
Do. 4½ % Pref.	10	4½	4½	8⅜ — 9½	..	4 12 4
Do. Second 6 % Pref.	10	6	6	10⅜ — 11	..	5 9 1
Do. 4½ % Deb. Stock	Stock	4½	4½	101 —103	..	4 7 5
Brompton & Kensington, Ord.	5	10	9†	7⅞ — 8⅜	..	5 19 4
Do. 7 % Cum. Pref.	5	7	7	7½ — 8	..	4 7 6
Central Electric Supply, 4 % Guar. Deb.	100	4	4	98 —101 xd	..	3 19 3
Charing Cross, West End & City	5	5	5†	3¾ — 4	..	6 5 0
Do. 4½ % Cum. Pref.	5	4½	4½	4¼ — 4⅝	..	4 12 4
Do. "City Undertaking" 4½ % Cum. Pref.	5	4½	4½	3⅞ — 4¼	..	5 5 11
Do. Do. 4 % Deb.	100	4	4	96 — 98	..	4 1 8
Chelsea, Ord.	5	5	4†	3⅞ — 4⅜	..	5 14 3
Do. 4½ % Deb.	Stock	4½	4½	99 —102	+1½	4 8 3
City of London, Ord.	10	7	6†	12⅜ — 13½	..	5 6 8
Do. 6 % Cum. Pref.	10	6	6	12 — 13	..	4 12 4
Do. 5 % Deb.	Stock	5	5	119 —123	..	4 1 4
Do. 4½ % Second Deb.	100	4½	4½	101 —104	..	4 6 7
County of Durham, 5 % First Mort. Deb.	Stock	5	5	89½ — 91½	..	5 9 8
County of London, Ord.	10	5	4†	8⅝ — 9⅛	..	4 18 8
Do. 6 % Pref.	10	6	6	11 — 11½	..	5 4 4
Do. 4½ % Deb.	Stock	4½	4½	108 —110	..	4 1 10
Do. 4½ % Second Deb.	Stock	4½	4½	99 —102	..	4 8 3.
Edmundson's, Ord.	5	Nil	Nil	⅜ — ⅝	..	Nil
Do. 6 % Cum. Pref.	5	Nil	Nil	2 — 2½	..	Nil
Do. 4½ % First Mort. Deb.	100	4½	4½	82 — 85	..	5 5 11
Folkestone	5	6	6†	4½ — 5	..	6 0 0
Do. 5 % Cum. Pref.	5	5	5	4⅝ — 5⅛	..	4 17 7
Do. 4½ % First Deb.	100	4½	4½	95 — 98	..	4 11 10
Hove	5	9	8†	6¾ — 7½	..	6 4 2
Kensington & Knightsbridge, Ord	5	9	8†	6¾ — 7½	..	6 4 2
Do. 4 % Deb.	Stock	4	4	94 — 96	+3	4 3
Kent Elec. Power, 4½ % Deb.	Stock	4½	4½	80 — 84	..	5 7
London Electric, Ord.	3	2	..	1 — 1⅜	— ¼	3 8
Do. 6 % Pref.	5	6	6	4½ — 4⅝	..	6 3
Do. 4 % First Mort. Deb.	Stock	4	4	89 — 93	..	4 7
Metropolitan	5	5	4†	3½ — 4	..	6 5
Do. 4½ % Cum. Pref.	5	4½	4½	4⅜ — 4⅝	..	4 14 9
Do. 4½ % First Mort. Deb.	Stock	4½	4½	101 —106	..	4 4 11
Do. 3½ % Mort. Deb.	Stock	3½	3½	84½ — 87½	..	4 0 0
Midland Electric Corporation 4½ % First Mort. Deb.	100	4½	4½	96½ — 98½	..	4 11 5
Newcastle-on-Tyne	5	4	4†	3½ — 4	..	5 0 0
Do. 5 % Pref., Non-Cum.	5	5	5	4 — 4½	..	5 11 1
North Metropolitan Power Supply, 5 % Mortgages (Red.)	100	5	5	99 —102	..	4 18 0
Notting Hill, 6 % Non-Cum. Pref.	10	..	..	10 — 11	..	..
Oxford	5	7½	6†	6½ — 6⅝	..	5 9 5
St. James' and Pall Mall, Ord.	5	10	10†	7⅞ — 8⅛	— ⅛	6 1 8
Do. 7 % Pref.	5	7	7	6¾ — 7¼	..	4 16 7
Do. 3½ % Deb.	100	3½	3½	86 — 88	..	3 19 7
Smithfield Markets, Ord.	5	Nil	..	1⅜ — 1⅝	..	Nil
South London, Ord.	4	5	..	2⅞ — 3⅛	..	6 3 1
Do. 5 % First Mort. Deb.	100	5	5	100—103	..	4 17 1
South Metropolitan, 7 % Pref.	1	7	7	1⅜ — 1⅝	+ ⅛	6 8 0
Do. 4½ % First Deb. Stock	100	4½	4½	98 — 98	..	4 11 10
Urban, Ord.	5	5	..	⅞ — 1	..	..
Do. 5 % Cum. Pref.	5	5	..	2 — 2⅛	..	..
Do. 4½ % First Mort. Deb.	100	4½	4½	86½ — 88½	..	5 1 8
Westminster, Ord.	5	10	10†	7⅜ — 8⅜	..	5 19 5
Do. 4½ % Cum. Pref.	5	4½	4½	5 — 5⅛	..	4 5 9

COLONIAL AND FOREIGN ELECTRICITY SUPPLY AND POWER.

Adelaide, 6 % Pref.	5	6	6	5⅞ — 5⅞	..	5 4 4
Calcutta, Ord.	5	8½	7†	6¾ — 7	..	6 1 5
Do. 5 % Pref.	5	5	5	5 — 5⅛	..	4 15 3
Calgary Power, 1st Mort. Bds.	100	5	5	96½ — 98½	..	5 1 6
Canadian Gen. El. Com.	$100	7	7†	112 —117	..	5 19 8
Do. 7 % Pref.	$100	7	7	118 —122	..	5 14 9
Cordoba Lt., Power and T., Ord.	1	3	3†	⅞ — 1 xd	..	3 0 0
Do. 5 % Deb.	100	5	..	94 — 97	+1	5 3 1
Elec. Lt. and P. of Cochabamba, 6 % Bonds	100	6	6	94 — 96	..	6 5 0
Elec. Supply Victoria, 5 % 1st Mort. Deb.	100	5	5	84½ — 87½	..	5 14 3
Elec. Dev. Ontario, 5 % 1st Mort. Bonds	$500	5	5	90½ — 92½	..	5 8 1
Kalgoorlie Elec. P. and L., Ord.	10/-	Nil	..	3/16 — 5/16	— 1/32	Nil
Do. 6 % Pref.	1	6	6	23/32 — 25/32	..	7 13 10
Kaministiquia Power, 5 % G. Bs.	$500	5	5	102 —104	..	4 16 2
Madras, Ord.	5	..	..	2⅜ — 3⅛	..	..
Melbourne, 5 % 1st Mort. Deb.	100	5	5	100—102	+2	4 18 0
Mexican El. Lt., 5 % 1st M. Bds.	..	5	5	88 — 90	..	5 11 1
Mexican Lt. & Power, Common	$100	4	4†	88 — 90	—1	4 8 11
Do. 7 % Cum. Pref.	$100	7	7	107½—109½	— ½	6 7 10
Do. 5 % 1st Mort. Gold Bds.	..	5	5	95½ — 97½	..	5 2 7
Monterey Rly. Light & Power, 5 % 1st Mort. Deb.	100	5	5	90½ — 92½	..	5 8 1
Montreal, Lt., H. and Power	$100	7	8	191 —196	+6	3 11 5
Northern, Lt., Power and Coal, 5 % 1st Mort. Bonds	$500	5	..	41 — 43	..	11 12 6
River Plate, Ord.	Stock	10	..	238 —243	+10	4 2 4
Do. 6 % Non-Cum. Pref.	Do.	6	6	104 —110 xd	..	5 9 1
Do. 5 % Deb. Stock	Do.	5	5	102 —104	..	4 16 2
Roy. Elec. Co., Montreal, 4½ % 1st Mort. Deb.	100	4½	4½	99 —101	..	4 9 1
Shawinigan Water, Capital	$100	4	5†	124 —126	+ ½	3 3 6
Do. 5 % Con. 1st Mort. Bonds	$500	5	5	107 —109	..	4 11 9
Do. 4½ % Per. Deb.	Stock	4½	4½	102½—104½	..	4 6 2
Toronto Power, 4½ % Deb.	Do.	4½	4½	100 —102	..	4 8 3
Vera Cruz Lt., P. and T., 5 % 1st Mort. Deb.	100	5	5	92 — 94	..	5 6 5
Victoria Falls Power, Pref.	1	Nil	11¾d.	⅜ — ⅞	..	..
West Kootenay Power and Lt., 1st Mort. 6 % Gold	100	6	6	106½—108½	..	5 10 7

TELEGRAPH AND TELEPHONE COMPANIES.

Amazon Telegraph	10	Nil	4†	7 — 7⅛xd	..	..
Do. 5 % Deb. Red.	Stock	5	5	99 —101	..	4 19 0
American Telep. & Teleg., Cap.	$100	8	8†	142 —144	—1	5 11 1
Do. Collat. Trust	$1000	4	4	95 — 97	..	4 2 6
Anglo-American Telegraph	Stock	3¾	3†	6⅝ — 6⅞	+ ⅛	5 9 6
Do. 6 % Pref.	Do.	6	6	110½—111½	— ½	5 7 7
Do. Def.	Do.	30/-	..	25½ — 26½	..	5 14 3
Anglo-Portuguese Tel., 5 % Mort. Deb.	100	5	5	101 —103	..	4 17 1
Chili Telephone	5	7	..	7 — 7⅛	..	4 16 7
Commercial Cable, Stlg. 4% Deb.	Stock	4	4	86 — 88	— ½	4 10 11
Cuba Telegraph	10	6	6†	10 — 10⅜	..	5 11 7
Do. 10 % Pref.	10	10	10	17 — 18	..	5 11 1
Direct Spanish Telegraph, Ord.	5	4	4†	3½ — 3⅝	..	5 6 8
Do. 10 % Cum. Pref.	5	10	10	8⅜ — 8⅝	..	5 14 3
Do. 4½ % Debs.	50	4½	4½	100½—102½	..	4 7 10
Direct United States Cable	10	4½	..	7⅞ — 8⅛	..	5 9 1
Direct W. India Cable, 4½ % Reg. Deb.	100	4½	4½	100 —102	+ ½	4 8 3
Eastern Telegraph, Ord. Stock	Stock	7	5†	137½—140½	+ ½	4 19 8
Do. 8½ % Pref. Stock	Do.	8½	8½	83¼— 85½	..	4 1 10
Do. 4 % Mort. Deb.	Do.	4	4	100¾—102½	..	3 18 1
Eastern Extension	10	7	5†	13⅛ — 13⅜	+ ⅛	5 1 10
Do. 4 % Deb.	Stock	4	4	100¾—102½	..	3 18 1
East and S. Africa Tel. 4 % Mt. Db. Mauritius Sub.	25	4	4	99 —101	..	3 19 3
Globe Telegraph and Trust	10	5⅞	6	10⅜ — 11⅛	..	5 6 8
Do. 6 % Pref.	10	6	6	12⅜ — 13⅛	..	4 10 9
Great Northern Telegraph	10	18	5†	32½ — 33½	..	5 8 3
Indo-European Telegraph	25	18	5†	56 — 58	..	5 12 1
Mackay Companies Common	$100	5	5†	86 — 89	..	5 12 4
Do. 4 % Cum. Pref.	$100	4	4	74 — 77	..	5 3 11
Marconi's Wireless Telegraph	1	5	..	2⅜ — 2⅝	..	..
Do. 7 % Cum. Partic. Pref.	1	16	..	1⅜ — 2⅛	— 1/16	..
Monte Video Telephone, Ord.	1	6	6	1⅜ — 1½	..	5 12 11
Do. 5 % Pref.	1	5	5	1⅛ — 1⅜	..	5 6 8
National Telephone, Pref.	Stock	6	6†	103½—105½	..	5 13 9
Do. Def.	Do.	6	6†	120 —122	— 2	4 18 4
Do. 6 % Cum. 1st Pref.	10	6	6	9⅞ — 10⅛	..	5 14 3
Do. 6 % Cum. 2nd Pref.	10	6	6	9⅞ — 10¼	..	5 17 1
Do. 5 % Non-cum. 3rd Pref.	5	5	5	5⅛ — 5⅜	..	4 10 11
Do. 3½ % Deb.	Stock	3½	3½	99 —101	..	3 9 4
Do. 4 % Deb.	Do	4	4	99 —101	..	3 19 3
New York Telep., 4½ % Gen. Bnds.	100	4½	4½	100¾—101½	..	4 8 8
Oriental Telep. and Elec.	1	8	..	1⅜ — 1⅝	..	4 18 6
Do. 6 % Cum. Pref.	1	6	6	1⅜ — 1⅝	..	4 13 8
Do. 4 % Red. Deb.	Stock	4	4	88½ — 90½	..	4 8 5
Pacific and European Tel., 4 % Guar. Debs.	Do.	4	4	100 —102	..	3 18 5
Reuter's	8	5	5†	8¾ — 9¼	..	4 6 6
Submarine Cables Trust	Cert.	6	6	130 —133	..	4 10 3
Telephone Co. of Egypt, 4½ % Deb. Red.	Stock	4½	4½	100 —102	+ 1	4 8 3
United River Plate Telephone	5	8	8	7⅜ — 7½	..	5 6 8
Do. 5 % Cum. Pref.	5	5	5	5⅛ — 5⅜	..	4 10 11
West Coast of America	2½	2½	2½	1⅝ — 1⅞	..	4 15 3
Do. 4 % Debs., 1 to 1,500 guar. by Braz. Sub. Tel.	100	4	4	99 —101	..	3 19 3
West India and Panama Teleg.	10	1½	1½†	2⅜ — 3 xd	+ 1/16	4 3 4
Do. 6 % Cum. 1st Pref.	10	6	6	10 — 10½ xd	..	5 14 3
Do. 6 % Cum. 2nd Pref.	10	6	6	9¾ — 10¼ xd	..	5 17 1
Do. 5 % Debs.	100	5	5	103 —105	..	4 15 3
Western Telegraph, Ltd.	10	7	6†	13⅜ — 14	..	5 0 0
Do. 4 % Deb.	Stock	4	4	101 —103	..	3 17 8
Western Union Tel., 4% Bnds. A	$1000	4	4	106 —109	..	3 13 5
Do. 4½ % Fdg. Bonds	$1000	4½	4½	100 —103	+ ½	4 7 5

* Unless otherwise stated, all shares are fully paid. † Interim dividend.

Continued on next page.

SHARE LIST OF ELECTRICAL COMPANIES.—(*Continued.*)

ELECTRIC RAILWAYS AND TRAMWAYS.—HOME.

NAME.	Stock or Share.	Dividends for 1910.	Dividends for 1911.	Closing Quotations Dec. 12th.	Rise + or Fall —	Present Yield p.c.
	*					£ s. d.
Bath Trams, Pref. Ord.	1	Nil	Nil	⅛ — ¼	..	Nil
Do. 5 % Pref.	1	5	5	⅝ — ¾	..	6 13 4
Do. 4½ % Deb.	100	4½	4½	80 — 85	..	5 5 11
Brit. Elec. Trac., Ord.	10	Nil	Nil	⅞ — 1⅛	..	Nil
Do. 6 % Pref.	10	1½	1½	3⅝ — 4⅜	..	3 8 7
Do. 5 % Deb.	100	5	5	92 — 95	—1	5 5 8
Do. 4½ % 2nd Deb.	100	4½	4½	78 — 82	..	5 9 9
Central London Railway, Ord.	100	3	3†	67 — 69	..	4 5 9
Do. Pref.	100	4	4	84 — 86	..	4 13 0
Do. Def.	100	2	.	50 — 52	..	3 18 5
Do. 4 % Deb.	100	4	4	102 —104	..	3 16 11
City & South London, Ord.	100	1½	1½†	30 — 31	..	4 16 9
Do. 5 % Pref., 1891	100	5	5	108 —110	..	4 11 0
Do. Do. 1896	100	5	5	104 —106	..	4 14 4
Do. Do. 1901	100	5	5	1.. —..	..	4 15 3
Do. Do. 1908	100	5	5	102 —104	..	4 16 2
Do. 4 % Deb.	100	4	4	100 —102	..	3 18 5
Dublin United Trams, 6 % Pref.	10	6	6	11 — 12	..	5 0 0
Great Northern & City, Pr'f. Ord	10	Nil	..	1 — 1⅛	..	Nil
Hastings Trams, 6 % Pref.	5	Nil	3†	⅝ — ¾	..	Nil
Do. 4½ % Deb.	100	4½	4½	73 — 78	..	5 14 8
Isle of Thanet Trams, 5 % Pref.	5	2½	..	2⅜ — 2⅝	— ⅛	4 6 11
Do. 4 % Deb.	100	4	4	77 — 82	..	4 17 7
Lancashire United, 5 % Deb.	100	5	5	79 — 82	..	6 1 11
London Elec. Railw'ys, 4 % Deb.	100	4	4	97 — 99	+1	4 0 10
London United Trams, 5 % Pref.	10	Nil	..	2⅜ — 3⅜	..	Nil
Do. 4 % Deb.	100	4	4	70 — 74	—1	5 8 1

NAME.	Stock or Share.	Dividends for 1910.	Dividends for 1911.	Closing Quotations Dec. 12th.	Rise + or Fall —	Present Yield p.c.
	*					£ s. d.
Metropolitan Railway Consol.	100	1⅝	2†	44 — 44½	+1½	3 1 10
Do. Surplus Lands	100	2⅝	3†	66 — 68	+1	4 0 11
Do. 3½ % Deb.	100	3½	3½	89 — 91	..	3 17 0
Do. 3½ % Pref.	100	3½	3½	85 — 87	..	4 0 6
Do. 3½ % Con. Pref.	100	3½	3½	84 — 86	..	4 1 5
Metropolitan District Ord.	100	Nil	..	31¼ — 31⅝	+ ⅜	Nil
Do. 6 % Deb.	100	6	6	144 —146	..	4 2 2
Do. 4 % Deb.	100	4	4	97 — 99	..	4 0 10
Do. 4 % Prior Lien	100	4	4	100 —102	..	3 18 5
Do. 4½ % First Pref.	100	3½	4½†	88 — 90	..	3 12 3
Do. 3½ % Gtd.	100	3½	3½	74 — 76	..	4 12 1
Metropolitan Elec. Trams, Ord.	1	5½	5†	⅞ — ⅞	..	5 12 4
Do. Def.	1	Nil	..	3/32 — 5/32	..	Nil
Do. 5 % Pref.	1	5	5	⅞ — ⅞	..	5 3 1
Do. 4½ % Deb.	100	4½	4½	102 —104	+ 1½	4 6 7
Do. 5 % Deb.	100	5	5	101 —103	..	4 17 1
Potteries, Ord.	1	2	..	7/16 — 7/16	..	..
Do. 5 % Pref.	1	5	5	13/32 — 15/32	— 1/32	6 19 3
Do. 4½ % Deb.	100	4½	4½	91 — 94	+3½	4 15 9
South Metro. Trams, 6 % Pref.	1	6	..	⅝ — ¾	..	6 17 2
Do. 4 % Deb.	100	4	4	72 — 77	..	5 8 11
Underground Elec. Railways	10	..	..	17/32 — 21/32	..	..
Do. 4½ % Bonds	100	4½	4½	100 —102	..	4 8 8
Do. 6 % Income	100	1	1½†	67 — 69	..	1 9 0
Do. Power House Debs.	100	4	4	100 —102	..	3 18 5
Yorkshire (West Riding), Ord.	5	Nil	..	⅛ — ¼	..	Nil
Do. 6 % Pref.	5	Nil	..	2⅜ — 2¾	..	Nil
Do. 4½ % Deb.	100	4½	4½	80 — 85	..	5 5 11

ELECTRICAL RAILWAYS AND TRAMWAYS.—COLONIAL AND FOREIGN.

Anglo-Arg. Trams, 1st Pref.	5	5	5½†	5 1/16 — 5 5/16	..	4 14 1
Do. 2nd Pref.	5	5	5½†	4 13/16 — 5 1/16	..	4 18 9
Do. 4 % Deb.	100	4	4	95 — 97	..	4 2 6
Do. 4½ % Deb.	100	4½	4½	101½ —103½	..	4 7 0
Do. 5 % Deb.	100	5	5	98½ —100½ xd	..	4 19 6
Auckland Trams, 5 % Deb.	100	5	5	104 —107	..	4 13 6
Bombay Elec. S. & Trams, Pref.	10	6	6	10⅞ — 11⅜	..	5 5 6
Do. 4½ % Deb.	100	4½	4½	98 —100	+1	4 10 0
Do. 5 % 2nd Deb.	100	5	5	98½ —100½	..	4 19 6
Brisbane Trams invt., Ord.	5	8	8†	8 — 8½	..	4 17 0
Do. 5 % Pref.	5	5	5	4⅞ — 5⅛	..	4 15 3
Do. 4½ % Deb.	100	4½	4½	103 —106	..	4 5 9
B. Columbia Elec. Rly., Def.	100	8	..	138 —142	—2	5 12 8
Do. Pref. Ord.	100	6	6	118 —122	—2	4 18 4
Do. 5 % Pref.	100	5	5	109 —112	..	4 9 3
Do. 4½ % 1st Mort. Deb.	40	4½	4½	99 —102	..	4 8 3
Do. 4½ % Vancouver Deb.	100	4½	4½	104 —106	..	4 4 11
Do. 4½ % Con. Deb.	100	4½	4½	102 —104	..	4 6 7
Calcutta Trams, Ord.	5	6	..	5⅝ — 6⅛	..	4 18 2
Do. 5 % Pref.	5	5	5	5 — 5¼	..	4 15 3
Do. 4½ % Deb.	100	4½	4½	102 —105	..	4 5 9
Cape Electric Trams	1	Nil	2½†	7/16 — 9/16	..	4 0 0
City Buenos Aires Trams (1904)	5	5	5	5⅜ — 5⅝	..	4 5 1
Do. 4 % Deb.	100	5	5	97 —100	..	5 0 0
Colombo Elec. Tr. & Lt., 5 % Deb.	100	5	5	98 — 98	..	5 2 0
Havana Elec. Rly., 5 % Bonds	$1000	5	5	102 —105	..	4 15 3
Kalgoorlie Elec. Trams	1	Nil	..	3/32 — 5/32	..	Nil
Do. 5 % A Deb.	100	5	5	92½ — 95½	..	5 4 9
Do. 6 % B Deb.	100	5	6†	60 — 64	—2	7 16 3

La Plata Elec. Trms, Prf.	1	6	6	29/32 — 1	..	6 0 0
Lisbon Elec. Trams, Ord.	1	5½	6†	1 — 1¼	..	4 8 0
Do. 6 % Pref.	1	6	6	1 — 1¼	..	4 16 0
Do. 5 % Deb.	100	5	5	96 —100	..	5 0 0
Madras Elec. Tr. (1904), Deb.	100	5	5	96 — 99	..	5 1 8
Manaos Trams & Lt., 1st Deb.	100	5	5	93½ — 95½	+1½	5 4 9
Manila Elec. R. and Ltg., Bonds	$1000	5	5	99½ —101	..	4 19 0
Mexico Trams Com.	$100	7	7†	123 —125	..	5 12 0
Do. Gen. Con. 5 % Bonds	..	5	5	98 —100	..	5 0 0
Do. 6 % Bonds	100	6	6	102½ —104½	+ ½	5 14 10
Para Elec. Rlys. & Lt., Ord.	5	10	10†	6¾ — 7¼	..	6 18 0
Do. 6 % Pref.	5	6	6	5¼ — 5⅝	..	5 4 4
Do. 5 % 1st Deb.	100	5	5	97½ — 99½ xd	..	5 0 6
Perth (W.A.) Elec. Tr., Ord.	1	2½	..	13/16 — 1	..	2 10 0
Do. 5 % 1st. Deb.	100	5	5	101½ —103½	..	4 16 7
Rangoon El. Tr. & Sup., Pref.	5	6	6	5¼ — 5⅝	..	5 9 1
Do. 4½ % 1st Deb.	100	4½	4½	98 —101	..	4 9 1
Rio de Janeiro Trams	$100	4½	5†	114⅜ —115⅜	— ⅛	4 6 5
Do. 1st Mort. 5 % Bonds	..	5	5	102½ —103½	+ ⅛	4 16 7
Do. 5 % Mort. Bonds	100	5	5	96 — 97	+ ¼	5 3 1
Sao Paulo Tram, Lt. and P.	$100	10	10†	187 —191	+1	5 4 9
Do. 5 % 1st Deb.	$500	5	5	102 —104 xd	..	4 16 2
Singapore Trams, 5 % Deb.	100	5	5	82 — 85	..	5 17 8
Southern El. Tr. B.A., 5 % Deb.	100	5	5	95½ — 97½	..	5 2 7
Un. Elec. Trams Monte Video	5	6	7	5⅝ — 6	..	5 0 0
Do. 6 % Pref.	5	6	6	5⅝ — 5⅞	..	5 11 7
Do. 5 % 1st Deb.	100	5	5	99 —102	..	4 18 0
Winnipeg Elec. Rly., 4½ % Deb.	100	4½	4½	104 —106	..	4 4 11

MANUFACTURING COMPANIES.

Aron, Ord.	1	Nil	6	3/32 — 5/32	..	..
Do. 6 % Pref.	1	9	6	3/32 — 5/32	..	7 2 2
Babcock & Wilcox	1	26	24†	5⅝ — 6⅛	..	4 5 0
Do. Pref.	1	6	6	1 — 1⅛	..	4 0 0
B.I. & Helsby Cables	5	10	8†	6⅝ — 7⅛	..	7 0 4
Do. Pref.	5	6	6	5⅝ — 6¼	..	4 16 0
Do. Deb.	100	4½	4½	102 —104	..	4 6 7
British Thomson-Houston, Deb.	100	4½	4½	94 — 97	..	4 12 9
British Westinghouse, Pref.	3	Nil	..	1/16 — 3/32	..	Nil
Do. Deb.	100	4	4	57 — 60	..	6 13 4
Do. 6 % Prior Lien	100	6	6	100 —102	..	5 17 8
Browett, Lindley, Ord.	1	Nil	..	1/6—2/-	..	Nil
Do. Pref.	1	Nil	..	5/- —6/-	..	Nil
Brush, Ord.	2	Nil	..	0 — 1/32	..	Nil
Do. 7 % Pref.	2	Nil	..	0 — ¼	..	Nil
Do. 4½ % Deb.	100	4½	4½	55 — 61	..	7 7 7
Do. 4½ % Second Deb.	100	4½	4½	39 — 44	..	10 4 6
Callender's Cable	5	15	10†	9 — 9⅜	..	7 13 10
Do. Pref.	5	5	5	5 — 5¼	..	4 15 3
Do. Deb.	100	4½	4½	101 —103	..	4 7 5
Castner-Kellner	1	17½	20	33/4 — 35/8 xd	..	5 10 4
Do. Deb.	100	4½	4½	104 —108	..	4 3 4
Crompton & Co.	3	Nil	Nil	⅛ — ⅜	..	Nil
Do. Deb.	100	5	5	60 — 70	..	7 2 10

Dick, Kerr	1	5	..	3/32 — 7/32	..	5 14 3
Do. Pref.	1	6	6	1 1/16 — 1 3/16	..	5 12 11
Do. Deb.	100	4½	4½	95 — 98	..	4 11 10
Edison & Swan, A, £3 paid	5	Nil	..	3/32 — 1	+ 1/16	Nil
Do. fully paid	5	Nil	..	1⅜ — 2⅜	..	Nil
Do. 4 % Deb.	100	4	4	70 — 74	..	5 8 1
Do. 5 % Second Deb.	100	5	5	77 — 80	..	6 5 0
Electric Construction	2	Nil	2½†	3/32 — 7/32	+ 1/32	..
Do. Pref.	2	7	7	1⅛ — 1⅜	+ ⅛	7 9 4
Greenwood & Batley, Pref.	10	7	7	7⅞ — 8¼	..	8 5 8
Do. Deb.	100	5	5	94 — 96	..	5 4 2
General Electric, Pref.	10	5	5	8¾ — 9⅛	..	5 6 8
Do. Deb.	100	4	4	85 — 90	..	4 8 11
Henley's, Ord.	5	15	10†	11⅞ — 12⅜	..	5 18 10
Do. Pref.	5	4½	4½	4 13/16 — 5 1/16	..	4 5 11
Do. Deb.	100	4½	4½	104 —106 xd	..	4 4 11
India-Rubber, G. & T.	10	10	..	9 — 11	— ⅜	..
Do. Pref.	10	5	5	9 — 10	— ⅜	5 0 0
Telegraph Construction	12	20	10†	35 — 37	..	6 7 5
Do. Deb.	100	4	4	100½ —102½	+ ½	3 18 1
Willans & Robinson	1	Nil	..	1/32 — 3/32	..	Nil
Do. Pref.	5	Nil	..	⅛ — ¼	..	Nil
Do. Deb.	100	4	4	53 — 63 xd	..	7 2 10

* Unless otherwise stated, all shares are fully paid. † Interim dividend.

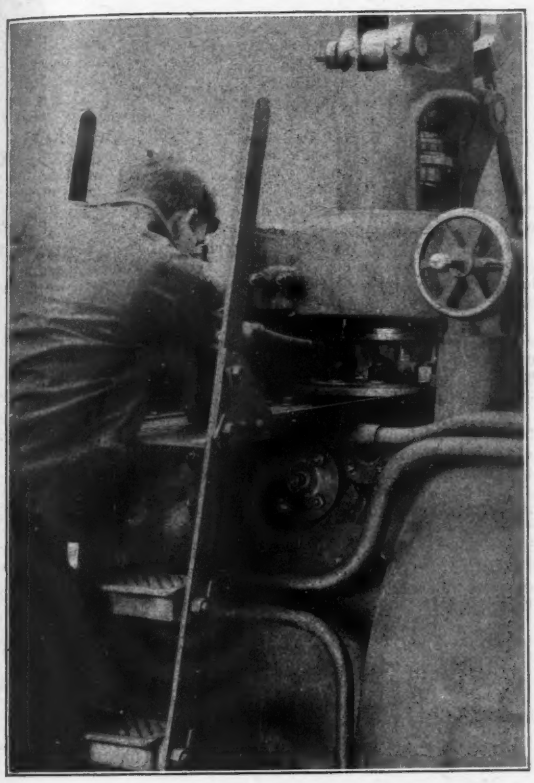
The yields are calculated upon the dividends paid for 1910.

Bank rate of Discount 4 per cent., September 21st, 1911.

THE B.H.P. GAS ENGINE.

THE introduction of producer plants for generating gas from cheap bituminous slack or all kinds of low grade fuel for gas engine purposes, stands to the credit of British scientists and manufacturers.

Very efficient producer plants have been installed for gasifying ordinary bituminous coal slack and converting the energy into electricity by means of gas engines.



VALVE ARRANGEMENT, B.H.P. GAS ENGINE.

The valuable contents of the coal are not exhausted to waste as in the case of the existing steam plants of to-day, but are treated for the recovery of valuable by-products.

The chief by-product obtained, viz., sulphate of ammonia, represents a value of about 12s. per cwt., and with native coals from 80 lb. to 110 lb. can be extracted from each ton of coal gasified, so that the utilisation of coal for producing power, and the recovery of valuable by-products at one and the same time offers, in some cases, a most economical solution of the power plant problem.

It is known that bituminous gas is apt to contain traces of tar, which tend to clog up the pistons and valves of the engines, unless special care is taken to avoid this.

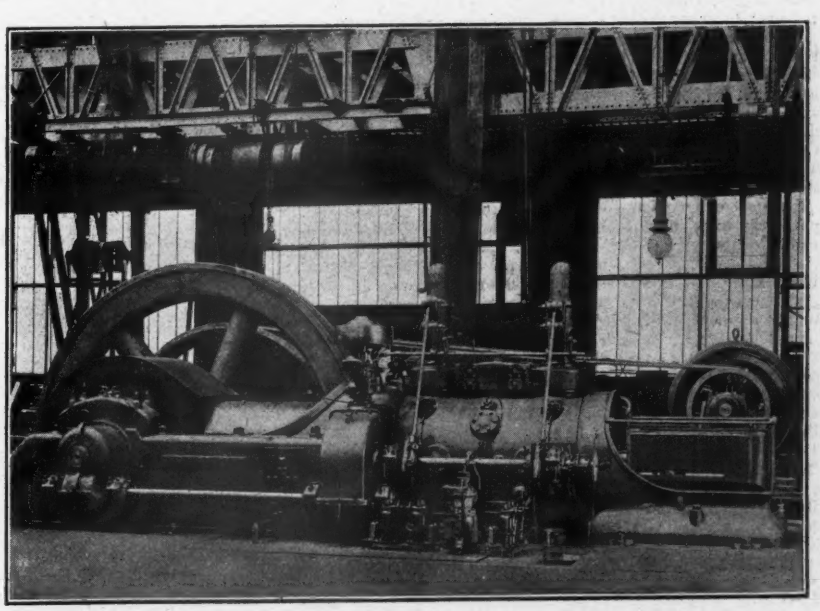
We illustrate an interesting gas-engine valve arrangement where special care has been taken in the design, in order to avoid any clogging due to tarry deposit, and from this it will be seen that the design provides special facilities for the removal of such deposits in the course of a few minutes. The illustration clearly shows how this is effected, and it is claimed that the operation could even be performed without stopping the engine, by merely shutting off the gas on that side of the cylinder, the valve of which has to be cleaned.

The arrangement is a departure from present-day practice, as it is generally known that gas engine valves can usually only be cleaned by dismantling the whole of the valve gear, and withdrawing the valves and valve cases. This is a source of great inconvenience on account of the time taken up, and also because of the necessary readjustments to the valve gear after the valves have been cleaned.

The valve is one of the improvements introduced by the British High Power Gas Engine Co., Ltd., and is a special feature of their engine known as the "B.H.P." gas engine. This engine is of the slow-speed horizontal type, which is claimed to be the most adaptable of all types for working with unclean gas. If tar should deposit in the cylinders of this type of engine, it would collect on the bottom of the cylinders, and would be swept out to the exhaust ports, which are arranged at the bottom of the cylinders, without adhering to the piston and piston rings.

It is probably on account of this and other advantages that engines of the slow-speed horizontal type have also, as is known, the best record for use in collieries with coke-oven waste gases, these gases frequently containing a fair percentage of tar.

The engines of the British High Power Gas Engine Co., Ltd., are built under licence by Messrs. Fraser & Chalmers, Ltd., of London and Erith, Kent.



THE B.H.P. GAS ENGINE.

PROCEEDINGS OF INSTITUTIONS.

Automatic Reversible Battery Boosters.

By R. RANKIN, A.M.I.E.E.

(*Abstract of paper read before the* INSTITUTION OF ELECTRICAL ENGINEERS, *London, November 23rd, and Manchester, November 28th*, 1911.)

(*Concluded from page* 965.)

CLASS (C).

In this class of booster control is usually made to depend on small variations in the generator current which it is desired to regulate, these small variations being turned to account to prevent the occurrence of larger variations. The regulation does not depend on exact design, but on the rapidity with which the regulator can act, and arrangements can be made to ensure very rapid action indeed.

Most makers of diverter boosters consider it necessary to laminate the entire booster field system; with boosters controlled by a quick-acting regulator there is no necessity whatever to have such a refinement as this.

The simplest system is that invented by Entz, the prominent feature of which is the carbon regulator.*

A notable feature of the Entz system is its simplicity. There is no complicated system of field windings to be designed in accordance with exact theory, and requiring patient adjustment on site, and consequently, exceedingly little trouble is experienced in putting it to work.

An important property claimed for this regulator is that when

* See ELECTRICAL REVIEW, July 8th, 1910.

the balance between solenoid pull and spring tension is disturbed the result, due to the sensitiveness of the carbon piles to change in pressure, is an exciting voltage for the exciter field, and hence an exciter armature voltage in excess of that actually required. This compels the booster field to build up to the required value very rapidly.

As instant reversibility is what is aimed at in every automatic battery booster, it will be seen that the possession of this property is an exceedingly strong argument in favour of the Entz and similar systems.

Since the Entz system was invented various other systems have been introduced employing the same principle.

The well-known Tirrill regulator has been employed in this way. Originally this regulator was used for voltage regulation, its operation being responsive to small variations in the voltage which it was employed to steady. Its application to the control of battery-booster plant is shown in skeleton form in fig. 4. The scheme of connections is the same as that of Entz, the two sets of carbon piles being replaced by two resistances, and the large solenoid by a diverter and a small solenoid. Variation of the

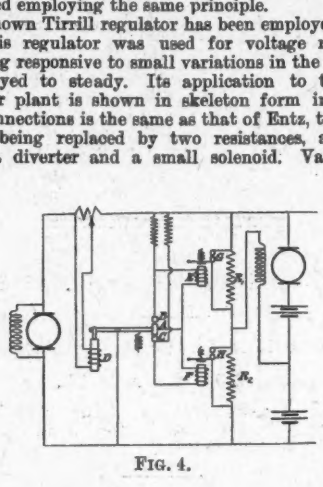


FIG. 4.

potential of the junction of the resistances, relative to that of the middle point of the battery, is obtained, not by variation of the resistances, but by their being entirely cut out by short-circuiting. Operation of the system is responsive to small variations in generator current reflected in the main solenoid. With the contact A occupying a position between contacts B and C, which will be when the spring is balanced by the pull on the magnet of the main solenoid D, the two relays E and F are energised, and both pairs of the corresponding short-circuiting contacts G and H are open. The resistances R_1 and R_2 being equal, there is therefore, under those conditions, no current in the booster field. A sufficient increase of solenoid current over that required to balance the tension in the spring causes the middle and upper contacts A and B to close. The relay coil on magnet E is therefore short-circuited and de-energised, and the contacts G close under the action of the spring shown in the figure. This, by short-circuiting the resistance R_1, throws the booster field directly across half the supply voltage, and produces a booster voltage tending to discharge the battery, but immediately the discharge exceeds the value required to bring the generator current back to its normal value, the main spring overpowers the pull on the solenoid core, and the middle and lower contacts A and C close, giving a charging tendency by means of F in a manner similar to that indicated above. Obviously the middle contact is never at rest, as, in order to get quick reversal of booster field, the complete cutting out of the resistances is designed to give an overshooting effect similar to that noted in connection with the Entz regulator.

The outline shown in fig. 4 is insufficient to give satisfactory practical results, it being necessary with the Tirrill regulator, as with most other regulators designed to give an overshooting effect, to adopt some principle of auxiliary checking control. The required checking effect is obtained by the use of what are termed "floating contacts."

It should be noticed that no type of auxiliary checking mechanism is used with the Entz regulator, this being due to the sensitiveness of the carbon piles to changes of pressure.

In the application of the Tirrill regulator, a resistance in series with a field winding is open and short-circuited alternately, but in the Taylor-Scotson scheme, the open and short-circuiting operation is performed directly on a field winding itself.* The regulator is mostly used for voltage regulation, and, so far as the author knows, has not been applied to the control of battery-booster plant in the ordinary way, but the action is made to depend on the rise and fall of line voltage at some point.

In the Tilney booster, which is classed as an externally regulated set, a potentiometer type booster field-regulating and reversing switch is operated by a small motor. The armature of this motor is connected through a resistance across the line voltage, and its field is wound differentially, one coil being excited from the bus-bars and the other carrying a portion of the generator current. The shunt coil is set so as to balance the diverter coil at the desired generator current. When the coils exactly balance each other the motor armature is stationary. An increase or decrease in generator current, due to an increase or decrease in line demand, disturbs the balance of the coils, and the armature accordingly revolves and regulates the booster field, until the battery current assumes the value necessary to bring the generator current to the correct value again.

The differential method of winding does not make for rapidity of action, and a further lag is introduced by the use of an ordinary field-regulating and reversing switch. There is no provision for over-regulation.

The Thury voltage regulator has been applied to the control of battery-booster plant. The action of the regulator is responsive to variations in bus-bar pressure, and a rise or fall of voltage from the desired value causes the regulator to act, and a booster voltage in an appropriate direction is the result.

The Thury regulator cannot be called quick-acting in the same sense, as, say, the Tirrill regulator, and it can readily be conceived that much trouble might be experienced with it should an attempt be made to make the operation dependent on the variations in generator current instead of line voltage.

Other systems which may be mentioned are those due to Lincoln and Bijur, which act on a principle similar to that of Entz. In both cases a controlling field is connected between the middle point of a number of cells and the junction of two resistances connected across those cells. In Lincoln's scheme, which is patented in connection with alternating-current systems, the torque of a small alternating-current motor, which is responsive to variations in main generator current, is balanced by a spring at the desired value of the current. An increase or decrease of generator current causes a rotation of the motor, and hence, by means of ordinary switches, a variation in the relative values of the two resistances connected across the cells, the controlling field being therefore energised in an appropriate direction.

In Bijur's system a solenoid is used, the pull on the core, which is due to the generator current, being balanced by a spring. Variation of the two regulator resistances is accomplished by means of contact points dipping into mercury cups.

In neither of those regulators is there any provision made for a back-checking action, and variation of the resistances could not conveniently be made so quick and yet so gradual as in the case of the Entz regulator.

The Brown-Boveri voltage regulator is applied as shown in outline in fig. 5. The resistances, each provided with a large number of contacts, are connected in Wheatstone bridge fashion, the booster field taking the place of the galvanometer. The terminals of the field are connected to two contact sectors A and B, which are fixed to a moving-coil system. The moving coil C moves in the gap of a differentially wound magnet D, and carries an approximately constant current. Absolute constancy of current is not indispensable. There is no spring or other control to bring the moving coil into any recognised mean position, but it can come to rest in any position which results in a balancing of the magnetic effects of the differential coils on D.

One of the differential windings is connected across the line voltage or a part of it, and the other carries a portion of the generator current to be regulated, the working of the scheme being as follows:—

The differential coils may be assumed to be balanced initially, with the sectors A and B in the mid-position shown in fig. 5, the line load being equal to the desired normal value which the generator should take, and the battery in a floating condition. The booster field will then have no current flowing in it.

An increase or decrease of line current will cause a corresponding alteration in generator current, which will upset the balance between the magnetic effects of the differential windings,

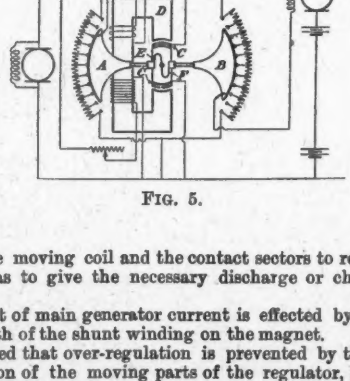


FIG. 5.

and cause the moving coil and the contact sectors to rotate in such a direction as to give the necessary discharge or charge booster voltage.

Adjustment of main generator current is effected by adjustment of the strength of the shunt winding on the magnet.

It is claimed that over-regulation is prevented by the lightness of construction of the moving parts of the regulator, and the provision of a special adjustable damping arrangement.

The springs E and F maintain the pressure between the contact sectors and the resistance contacts, and the pivoting of the sectors in coned cups as indicated in the figure, gives a rolling and practically frictionless contact between sectors and contacts, the latter being arranged on an arc, the radius of which is somewhat greater than that of the face of the sectors.

This regulator possesses the defect of all differential systems in that compounding of the main generator will affect its working. The ways in which a battery-booster plant can be used are many and varied. In three-wire systems it is quite common practice now to run the battery and booster across the outers of the system like a two-wire set. A three-wire set consists merely of two sets with a common point at the middle wire of the system. For satisfactory working the exciter field regulators have to be interlocked.

Exceedingly good results are obtained by the use of the battery and booster directly connected across the outers of the three-wire system in conjunction with a separate balancer. For example, in

* See ELECTRICAL REVIEW, February 17th, 1911.

one station, shunt-wound generators are run directly across the outers in parallel with a battery and automatic reversible booster, and a rolling-mill motor-load is supplied from the same bars as public and general lighting without any adverse effect on the voltage. Also, in the ELECTRICAL REVIEW, Vol. LXVII, page 59, plant was described which is in operation at Blackburn Corporation Electricity Works, and which makes provision for the town traction to be supplied from the outers of the three-wire lighting and general supply system through a motor-generator. A battery and booster operate in parallel with the generator side of the set, and equalise the load so that the variations are not noticed on the three-wire system. The generator current is held steady within about 20 amperes from the mean, which is normally 600 to 800 amperes.

Arrangements such as have just been mentioned are often capable of showing large economies, but before an engineer definitely decides to supply such highly fluctuating loads from his lighting bus-bars, he should satisfy himself thoroughly that the equalising system he chooses is capable of giving the results he wants, and the best way to make sure of this is to see a similar plant in satisfactory operation.

Balancing on a three-wire system where a two-wire battery and booster are used, instead of being obtained by means of a separate rotary set, may be effected on the armature of the booster motor by means of a choking coil in the middle wire of the system connected to slip-rings on the armature. This, of course, means that the motor armature has to be larger than would otherwise be the case, the increase in size depending on the magnitude of the out-of-balance current. As an alternative to this the booster may be balancer-driven, in which case the balancer machines require to be made larger than is necessary to deal with the out-of-balance current, the increase in size being dependent on the power required to drive the booster. In all those cases a middle-wire connection should be provided for the battery, and at times of light load or in emergency, balancing can be done by means of the battery.

Colliery winding and similar work provides an opening for battery-booster plant of an instantly reversible character, provided the initial cost can be kept down. Fly-wheel sets are often employed, but the large reserve of power in a battery would be a distinct advantage in many cases. There is no necessity to limit the use of this type of winding plant to direct-current systems, as it can be equally well applied to systems in which the supply takes the form of alternating current. The system is, of course, in competition with fly-wheel equalisers on both alternating-current and direct-current systems, but a fly-wheel, although it decreases the peak power drawn from a supply, cannot flatten out the demand in the way a sensitive battery-booster plant can, and, where power is taken from a supply company and paid for on the basis of maximum demand, this is a point worthy of serious consideration.

With a good external automatic regulator the benefits of accumulator storage can be readily obtained on alternating-current systems. Very little has been done in this direction in this country, but very large installations have been put down in America operating on this principle. The most prominent name in this connection is that of Woodbridge, some of whose devices will now be described.

As in the case of the direct-current booster, perhaps the simplest arrangement is the employment of an Entz regulator operated by an alternating-current solenoid, responsive to variations in the

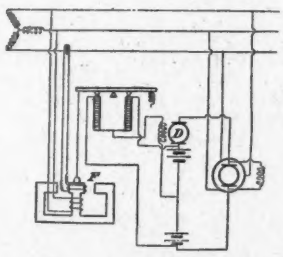


FIG. 6.

energy component of the alternating current, the regulator controlling the A.C.-D.C. transmitting plant. Such a solenoid is shown at F in fig. 6.

It consists of an iron magnetic circuit magnetised from the line potential difference on the A.C. circuit, the magnetising coil being shown wound round the middle yoke. On the enlarged end of this middle yoke there is placed a movable coil, which is suspended from one end of the lever of an Entz carbon regulator; the coil is connected across the secondary of a current transformer, the primary of which is in series with the main which has no voltage connection. The flux in the core splits and crosses two air-gaps to re-enter the centre core, and, being produced by the potential coil, connected as shown, will lag 90° in phase behind the line voltage. At unity power factor in the main A.C. circuit, the current in the movable coil will lag 90° in phase behind the voltage across the potential coil, and hence the current in the movable solenoid and the flux in the air-gaps will be in phase with each other, and a pull will be exerted by the solenoid on the lever of the regulator, the pull being proportional to the product of the flux in the air-gaps and the current in the solenoid. If the power factor is not unity the pull of the solenoid will be proportional to the product of the magnetic flux in the air-gaps and the energy component of the current, this component being, of course, in phase with the flux. The wattless component of the main alternating current will have no effect on the lever of the regulator. The effect of the pull on the lever will be to operate the Entz regulator in the usual manner. An increase in A.C. energy above the desired mean will cause the booster D to discharge the battery into the rotary circuit. If the energy in the main A.C. circuit falls below the desired mean (this mean being obtained by adjustment of the regulator spring, as usual) the booster voltage will be in the charge direction, and energy will be transmitted from the main alternating-current circuit *via* the rotary converter into the battery. Other types of external regulator may be used in a manner similar to that just described.

Either the motor-generator or the converter type of plant may be used for the transference of power, but the latter is more suitable where quick regulation is required, as the single converter machine will respond to the control somewhat more quickly than will the combination forming the motor-generator. The boosting effect necessary to cause a transference of energy between the battery and the load circuit may be obtained by the provision of a D.C. booster on the battery side of the transmitting plant, as indicated in fig. 6, or an A.C. booster on the load side.

In order that the auxiliary booster plant might be dispensed with, the split-pole rotary converter was developed. In the ordinary converter, there is, of course, a fixed ratio between A.C. and D.C. voltages, and the object of the split-pole machine is to allow of a variable ratio by causing the D.C. voltage to vary in response to load variations in the generating plant, while the A.C. voltage is maintained constant, or approximately so.

The raising and lowering of the D.C. voltage can be utilised to cause a battery connected across the D.C. terminals of the rotary to charge and discharge, alteration of the converter field being made responsive to small variations in the generator load by means of an automatic regulator.

The split-pole converter has also been used as a two-part pole machine with success, and it is found that, with a 20 per cent. variation of direct-current voltage above and below the mean—*i.e.*, 20 per cent. on each side—the variation in alternating-current voltage is about 1 per cent. on each side of the mean value. Plant of this type is in very successful operation in the Gary works of the Indiana Steel Co.

Mr. Woodbridge has described a new form of automatic exciter suitable for controlling equalising plant on alternating-current systems.

At the Gary works of the Indiana Steel Co., where the foregoing apparatus is in actual use, the rolls of the rail mill are driven by five induction motors aggregating 22,000 H.P., comprising three units of 6,000 H.P. and two units of 2,000 H.P. It has been found necessary, although the large motors have been provided with equalising fly-wheels, to install a storage battery to take care of the load fluctuations on both alternating-current and direct-current parts of the system. The battery consists of two sets of 125 cells, each set capable of giving 4,320 amperes for one hour and 8,640 amperes on the peak for regulating purposes. Regulation on the alternating-current load is affected by means of split-pole converters and Woodbridge's special exciters, and on the direct-current load, by means of boosters controlled by Entz regulators.

One of the most valuable results obtained by the use of the battery equalising plant is the increased speed and output of the rail mill, a very decided reduction in output being the result of a disconnection of the battery.

There is installed at the collieries, Hucknall Torkard, Nottinghamshire, an A.C.-D.C. plant, including a battery-booster equipment, in which the booster is of the Lancashire diverter type, and only equalises on the D.C. load.

The figures given below were obtained from a test made in a works where a battery and an Entz booster were used to equalise on the total load. The first part of the test was made with one generator working during the day, and two at night when the lighting load came on, and the second part with the battery-booster plant and one engine only in use over the whole period. Some time after the tests were carried out extensions were made which would have necessitated the running of two engines day and night, and, had a test been made then, the saving due to the equalising plant would have been even more marked. The load was of an exceedingly fluctuating nature, worse even than a traction load, and, taking into account the reduction in wear and tear of the generating plant, in addition to the coal saving, a very few years will be necessary for the battery and booster plant to entirely repay the capital initially put out on it.

It will be observed that, as the second generator was only required for about one-third of the running time of the first part of the test, the conditions of load were not the most favourable to show the maximum economy made possible by the battery and booster plant. The generator which ran through the whole of the first part of the test was the one used with the booster. The engines were of the high-speed non-condensing type.

Running plant.	Duration of test. Hours.	Total units.	Average KW.	Steam per hour. lb.	Steam per KW-hour. lb.
Two generators	138	8,536	61·85	3,735	60·43
One generator with battery and booster	136	8,330	61·25	2,649	43·25

One generator ran 48 hours and one the whole 138 hours. From the above the saving in steam per KW.-hour is 17·18 lb. or 28·4 per cent.

In the ELECTRICAL REVIEW, Vol. LIX. page 179. it is stated that at Greenock Corporation Electricity Works, where the traction load was about ⅞ths. of the total load on the station, the installation

of an Entz booster and battery reduced the coal per unit generated from 6¼ lb. to 5 lb.—that is, made a 20 per cent. saving in the total coal bill. It was estimated that the plant would pay for itself in from three to four years.

In another traction station, where the generating plant consists of Diesel oil engine sets, the installation of a Lancashire booster and a battery made a reduction of 18 per cent. in fuel consumption.

In the installation of a battery and booster on a highly fluctuating load, both the generator and battery are operated under satisfactory conditions, for it is a fact that batteries working under such circumstances usually remain in very good order indeed. For example, the battery at Greenock already referred to was not on maintenance, and was in use for six years before any money was spent on it, and then it only required cleaning out.

Discussion in London.

Mr. J. S. Highfield, in opening the discussion, said the author referred to the general use of batteries, and he agreed with his remarks, but he wished makers would devise some method of maintenance charging by which the owners of healthy batteries did not have to pay for the unhealthy ones. The difficulty in designing automatic boosters was due to the battery charge and discharge curves not being straight, especially towards the end of charging, and various devices were required to meet the curve. In his view it was not advisable to take account of the extreme end of the load curve; very few boosters would meet the full requirements, and the Thury regulator was perfectly adapted for dealing with slow fluctuations. It was essential to put a heavy fly-wheel on the booster if it were used for rapidly fluctuating currents. Laminated fields gave increased sensitiveness, and were essential with bi-polar machines. For traction loads, where a battery and booster were provided, he thought that shunt-wound machines were quite able to deal with the usual fluctuations.

Mr. A. M. Taylor said it was necessary to differentiate between time and instantaneous peaks—the automatic booster was no doubt valuable for instantaneous pressure variations, which so far as large traction loads were concerned, were negligible. A stand-by battery on a lighting system should be available for preventing a complete shut down; the battery would stand it, but not the booster. In Birmingham the sudden failure of the D.C. supply might throw a load of 20,000 amperes on the battery, which would bear this for three minutes or so. In cases of this kind it was common practice to arrange for an automatic circuit-breaker to disconnect the battery from the bus-bars; but he considered that, on the contrary, no automatic device for disconnecting should be used, but that a short-circuiting arrangement (intended only for closing the circuit) should be provided for the boosters, and thus link battery and bus-bars direct when the emergency arose. A booster to meet such conditions would cost comparatively little, and the arrangement was being adopted in Birmingham. The cost of boosters used in the ordinary way might easily be heavy, especially when the whole range of charge and discharge was dealt with by one machine, and compared unfavourably with the use of regulating cells. By adopting some such method as that indicated in his paper before this Institution (see Electrical Review, May 5th, 1911), it was possible to reduce the cost from 60 to 80 per cent. His proposed series-parallel arrangement used in conjunction with automatic boosters would effect a saving in size of boosters. The Continental combination of automatic control with regulating switches and end cells had attained a high degree of perfection, but boosters were preferable if the cost were not too high. He thought there might be scope for the use of automatic reversible boosters in conjunction with batteries on alternating-current systems, as suggested in his paper, to correct for power factor as well as to take the peak loads. In Birmingham they employed a Tirrill regulator on the A.C. supply, and in their case he did not think any economy would have resulted from the use of battery plant for the A.C. system.

Mr. H. Burge said that properly designed boosters of the Pirani type overcame the difficulties mentioned by the author, especially with machines of the interpole type. If suitable adjustments were made, the two-coil type of booster gave such good results that extra complications were not needed; they only added to the sluggishness. The colliery-winding installation with Pirani machines actually boiled down in practice to a simple three-machine set.

Mr. B. M. Jenkin dwelt on the question of time lag in the diverter type of booster. He had noticed in a railway sub-station that the power motor-generators took momentary overloads for a second or two, while the booster built up its field, and it had occurred to him that he could have saved the expense of the booster plant by frankly letting the motor-generators take the momentary overloads. The diverter type of booster involved expense, and comparison with the booster and Tirrill regulator showed the latter to be very simple indeed. If the latter was good enough it should mean a saving in the case of a large battery installation.

Mr. G. C. Allingham said boosters fell into two classes, those controlled by line current and those controlled on the relay principle by generator current. It appeared to him that the Highfield booster was unstable in exactly the same way as the three-coil type Pirani booster, while the Lancashire booster controlled by generator current was quite stable.

Mr. E K. Scott said the differential booster did not give a straight line curve, but it knocked off a big peak and gave what was wanted in practice. The homopolar machine could easily be differentially and cumulatively compounded, and he thought its possibilities had been overlooked in booster work.

Mr. W. M. Mordey recalled the fact that the old Brush regulator was the fore-runner of all the carbon pile regulators of to-day.

The Author briefly replied to the various points raised.

Discussion at Manchester.

Mr. McKinnon said that he knew of a number of cases where the possibility of a considerable saving was entirely spoilt owing to either wrong design of booster or insufficient operating staff. Makers appeared to consider overload merely a matter of speculation. Travelling through Germany, he found many installations representing the Tirrill, Tilney and Thury methods, but unfortunately they were rarely in operation.

Mr. Cooper said that looking into the Greenock figures, there was a big saving in coal, but the maintenance charges had also increased, and this he contended was due to the battery. He had compared the Greenock figures with his own and found that his station without a battery came out very favourably.

Mr. P. P. Wheelwright said he had had an Entz booster in use for some years on traction and lighting load, and his report was reduction of coal bill, reduction in cost of repairs, and simplicity of operation. The booster handled a variation of 800-3,000 amperes very rapidly and with almost straight-line regulation. Before purchasing this booster, he inspected other types, but found them either out of operation or very sluggish. He had come to the conclusion that the Entz regulation was as good as was possible for a mechanical device.

Mr. J. Frith said that his impression of certain regulators was that they went a long way round to effect a change, but he certainly thought that the Tirrill and Entz regulators got there quickly. Had the author thought of the possibility of using a very highly inductive diverter, more inductive, in fact, than the field magnets?

Mr. C. L. E. Stewart said his experience of the Lancashire booster had been a very happy one. The machine had run for over 2½ years with very little stoppage and remarkably quick action. A number of lighting consumers were fed from the traction mains governed by the booster, and hitherto no complaint had been made, in fact the chart showed straight-line regulation.

Mr. Cyril J. Hopkins (communicated) said that the author stated that the presence of a heavy fly-wheel on the engine also affected the quality of the results with some boosters, in the same way as over-compounding on a generator, or the governor of an engine attempting to make the engine follow the load. This was true as far as the results recorded in the generator load chart were concerned; however, the fly-wheel effect was an efficient one, since it did not make an uneconomical demand upon the steam consumption, whereas over-compounding on a generator or the governor of an engine did, so that the results were not strictly comparable, and there seemed to be no question as to the desirability of a fly-wheel, even though it might appear to interfere with the evenness of the generator load.

Mr. C. C. Atchison was doubtful whether rapidity of action was always essential. He regretted that in some stations the boosters were lying idle; this did not necessarily reflect discreditably upon the booster. In connection with batteries and boosters, it was a question of time to decide whether reduction of coal costs would not be outbalanced by interest on sinking fund and capital expenditure and maintenance. It was the large undertakings that would prove the strength of the argument, and the fact that Manchester had recently installed a large battery said much for the benefits to be derived. He had obtained a distinct advantage in being able to get a very steady voltage on traction load, whereas formerly it was very irregular indeed. He appreciated the use of batteries as far as he had gone, and the Entz booster had been very satisfactory.

Mr. H. C. Crews referred to some good results which he had obtained on a lift installation using a Lancashire booster. Tests extending over an hour with variations of load from zero to maximum showed a voltage variation of only 5 in 230.

Mr. R. Rankin, in reply, said that, contrary to Mr. Cooper's contention, the battery at Greenock did not account for any increased maintenance charges. Highly inductive diverters were very clumsy and expensive articles, and he did not advocate their use. Laminated field magnets were in themselves very expensive, and it was difficult to persuade people that lamination was unnecessary. He was glad to hear of Mr. Stewart's success with the Lancashire booster, and had no intention to run down that type of machine. In reply to Mr. Wilkinson, the only reason he could suggest for the lack of development of boosters and battery regulators in this country was that there were but few openings for this class of machinery. Boosters other than the Entz could not be described as quick acting; nevertheless, they had a field of their own on, say, lighting load, and it was desirable that they should adhere to this field of operation. Any engineer desiring a constant generator load could obtain it by employing a quick-acting booster. Regarding the remarks of Mr. Crews, the author thought the generator large enough to do the requisite work without the addition of a booster.

Electricity in Mines.

At Armstrong College, Newcastle-on-Tyne, on November 15th, Prof. Thornton, President of the Newcastle branch of the Association of Mining Electrical Engineers, delivered his presidential address. He said the result of the Coal Dust Commission now sitting was of vital interest to mining electrical engineers, for with the coal dust suppressed and safe in every part of the mine, electricity could be used without the least possibility

of danger except where gas was present in large quantities and in the high percentages required for explosive ignition. Even in this case it could be made safe if one could have confidence in attention and inspection on the spot, but few would be found willing to advocate the use of electricity or any other possible source of open flame, where gas was likely to be present in bulk. With regard to cables in dusty or fiery mines, to be on the safe side armouring was advisable, but with coal dust absent or fixed, unarmoured cables would do equally well in cases where mechanical damage was not immediately possible. With regard to plant in general, and in view of the new facts which had been ascertained relating to gas and coal dust, it could not be too often said that a widening of our knowledge of the possibilities of accident was less than useless unless means were taken, by persuasion of those in authority, to face renewals or changes which made for certain safety.

Prof. Thornton spoke in terms of high appreciation of Mr. Ralph's new lamp for the detection of the presence of small quantities of gas, and said the lamp promised to give certainty where before there had only been conjecture. Mr. Ralph had lent him one of the detectors, and measurements were made on the lines of those demonstrated to the Association two years ago on the ignition of coal dust by single flashes, but now in air containing small percentages of coal gas. The speaker then described the apparatus. He said that to produce a flash a measured current from a 480-volt direct-current supply was passed through non-inductive resistances and interrupted when desired by sliding a rod back, so as to break an end-to-end contact in the middle of the box. A cloud of dust was obtained by blowing a single puff of air through a storage bottle into the explosion chamber. The air in a pressure vessel was mixed to ½ per cent. with coal gas in a reservoir, and was at a pressure of 2½ in. of mercury; the heater showing the desired percentage of gas present, a cloud of dust was made and the switch immediately opened. Below a certain current nothing happened beyond a slight dull yellow burning of dust in the arc. Sometimes this spread in the box or ran towards one side; this was called a partial ignition, the rise of pressure being negligibly small. When the ignition was so complete in the box that it travelled out of the exit tube in flame and smoke, it was called a full ignition.

In the previous series it was found that a current of 4·5 amperes just failed to ignite a cloud of the coal dust then used. In the present case, using the finest unsifted screens dust, out of 120 trials with 4·5 amperes broken and with no gas present, there were eight full ignitions, or 6·7 per cent. Gas was then admitted, and the following observations were made. Control runs with no gas present were taken from time to time, and a longer run at the end. The indicator was calibrated in measured quantities of coal gas. The following table gives percentage ignitions of coal dust in dense clouds with small percentages of coal gas present:—

Percentage of gas present ...	0	½	1	1¼	1½	2	0
Number of trials	120	130	63	50	20	15	50
Number of full ignitions ...	8	19	18	23	13	15	3
Percentage of full ignitions ...	6·7	15	27	46	65	100	6

The total number of trials was 448. The influence of gas in helping the ignition of coal dust was evident at every stage. That it should have effect down to zero was unexpected, though not, perhaps, surprising when it was considered that, however small a quantity was present, its combustion must add to the effect. It was as a carrier of the ignition beyond the arc between the separated particles of coal dust that the gas might act, for it seemed to be a point worth further investigation that when the volume of the initial ignition reached a certain limit, different, no doubt, for each kind of dust, full ignitions were more certain to occur. It was mostly a question of temperature and duration of flash so far as the dust was concerned; the exact part played by the gas was beyond the scope of the investigation.

The experiments were made with the same quality of dust throughout from a supply sent from Urpeth Pit. It was found to be very necessary to do this in order to obtain regular results. It was also necessary to keep the current exactly the same throughout, and the speed of break. In order to show in another way the influence of gas, the current was lowered until—at 3·3 amperes—no ignition occurred at break—that is, out of 50 trials there were no full ignitions. With 1½ per cent. of gas then admitted, there were 15 full ignitions out of 30 trials, giving 50 per cent., and with 2 per cent. of gas, out of 18 trials there were 14 full ignitions, or 77 per cent. The presence of a small percentage of gas was, therefore, able to cause ignition of coal dust by a flash which, by itself, would not ignite it—a point discussed by Prof. Galloway 30 years ago, and investigated by the Prussian Fire-damp Commission by an examination of the length of flame produced by a blown-out shot in a mixture of gas and dust.

The great question arose at what point should practical experience and common sense advise to cut off the electrical supply in a mine. The figures as they stood undoubtedly supported the action of the House in Committee in keeping the percentage low. Everything pointed to 1 per cent. as a reasonable limit for any possible source of ignition, electricity or naked light, to be withdrawn from the mine. Speaking with a knowledge of the consequence of coal mine explosions, he suggested that the maximum of safety with the least interference with the operation of getting coal, and with a minimum of ri-k, would be obtained by fixing the limit at which electricity should be withdrawn at 1 per cent. The facts brought out were of wider interest than from the electrical side of the question. They showed to what degree small quantities of gas might augment a local ignition in the workings, and the use of haulage in return airways, where both clouds of dust and small quantities of gas were likely to be present together, was once more condemned.

Electric Lighting of Railway Trains.

By Roger T. Smith, B.Sc.

(*Abstract of paper read before the* Institution of Civil Engineers, *November 28th*, 1911.)

In this paper the author deals with the method of train lighting in use on the Great Western Railway, with axle-driven dynamos and accumulators controlled by an automatic regulator, usually installed on brake vehicles only, the other coaches being supplied from them. By this means the capital cost and maintenance costs are reduced.

After a good deal of experiment, the author has decided that the illumination on a horizontal plane at the level of the eye (about 4 ft. from the floor) should never be less than 1½ ft.-candles; he aims at providing 2 ft.-candles in third-class and 2½ in first-class coaches.

The standard of illumination required in the coaches is affected by the maximum illumination given on the station platforms, for if a compartment is less brightly lighted than the platform, the entering passenger receives the impression that the lighting is poor, and this impression persists. Platform lighting should range between ¼ and 2 ft.-candles, and hence the compartment lighting should not fall below the latter figure.

Glare must be avoided; it can be greatly diminished by placing the lamps high up (never under the luggage rack) and providing a white enamel surface behind the source of light, so that the latter is always seen against an illuminated surface. Frosting the bulbs or globes diminishes glare, but collects dirt; holophane globes prevent glare and give an excellent distribution of the light.

The most satisfactory rating for tungsten lamps for train lighting is 1·3 watts per candle, giving a useful life of about 850 hours. On the Great Western Railway the lamps are only changed once in 12 months, having an average life of 900 hours. In each first-class compartment five 10-c.p. lamps in pine-shaped diffusing holophane globes are used, and in a third-class compartment three 10-c.p. lamps. The voltage at the lamps should be kept within 2½ per cent. above or below the normal, which is fixed at 22 volts on the Great Western Railway, being the terminal pressure of a battery of 12 cells when fully discharged.

It is necessary to provide a charging voltage of 2·5 volts per cell, with means to raise the voltage to 2·75 volts when necessary to cure sulphation of the plates. The best results are attained with neither constant-current nor constant-pressure charging, but a compromise whereby the current is large during the early stages of charging and diminishes, under the control of an automatic regulator, almost to zero at full charge, eventually leaving the battery practically floating on the dynamo. These conditions are ideal, and batteries examined after 12 months' use have been found in perfect condition.

The active material in the lead cell seems to be limited to a life of 5-7 years, but this may possibly be increased to 10 years. The cost of renewals and maintenance can be quite accurately determined from experience; an allowance of 10 per cent. per annum on the capital cost of the complete cell covers the whole. Chronic over-charging is much more harmful than occasional over-discharge.

The fewer the cells used the less costly is their maintenance, almost irrespective of their size. A mechanical regulator which enables a duplicate battery to be dispensed with saves initial cost, and 80 to 90 per cent. of the maintenance cost, as well as nine-tenths of the weight of the second battery, and is, therefore, preferable.

The dynamo is always driven by belt, and the casting of the belt is a difficulty calling for careful attention. The flanges of belt pulleys should be at right angles to the pulley axis. Ball-bearings save their extra cost in a few months. The dynamo must be totally enclosed in a dust proof and watertight casing, for when an engine is taking water from a trough the dynamo on the coach next the engine may be drenched, and the oil has often been washed out of oil wells.

An electromagnetic automatic cut-in and cut-out switch is recommended in preference to a centrifugal switch, as it cuts in at the right voltage irrespective of speed, and can be made to serve as a reverse current circuit-breaker. The worst thing that can happen to a train-lighting dynamo is a short-circuit in the armature, as the battery is heavily discharged before the fuse blows, just when its capacity is about to be drawn on to the utmost.

On the Great Western Railway, when the dynamo terminals were intentionally short-circuited, the cut-out opened on reverse current before the fuse could warm up. The automatic regulator must control the lamp voltage within 2½ per cent. while the battery voltage varies between 22 and 33 volts, and the lamp load between 10 and 100 per cent. of full load; it must also control the dynamo so as to charge the empty battery at full output, and to reduce the charging current as the process goes on, until the battery is full, after which, if the lamps are on, it must feed the lamps from the dynamo with the battery floating. All these conditions can be complied with.

[over

While the working and maintenance costs of a self-contained electric lighting system do not differ much from those of oil-gas lighting for the same illumination, the capital charges of the former exceed those of the latter. But if only the brake vehicles are equipped with dynamo and battery and supply current to the other coaches, which are wired only, an economy is effected. It is sufficient for each brake vehicle to supply four other coaches at most besides itself, two such equipments being provided per ten-coach train. As each train has one or more brake vehicles, and the other coaches are provided with through cables and couplers, the trains can be made up in any order, and there is no need for block trains. Assuming the whole of the passenger rolling stock

of the Great Western Railway to be electrically lighted, 27 per cent. of the main-line stock would have to be equipped with apparatus, as well as composite and slip coaches (all brake vehicles) which leave the main-line trains *en route*, amounting to 10 per cent. of the stock. Of the local and branch-line coaches 39 per cent. must be equipped. The capital cost would thus be reduced by 35 per cent., and the running costs by 40 per cent., while the reliability of working would be increased, as all the batteries and generators on a train work in parallel. The arrangement allows of 30 per cent. of the equipments on a train being out of use without inconvenience, and the increase in reliability is of greater value to the railway than the saving in cost. When the generators thus work in parallel, it is essential that they must be rigidly limited in output, so that a dynamo cannot become overloaded. As far as could be ascertained, only one system made in England fulfilled the necessary conditions regarding the limited output of the generator and the regulator—namely, the Leitner standard apparatus.

To test the brake-vehicle method, a six-coach corridor train was equipped and started running in March, 1909. It was lighted with 142 10-C.P. tungsten lamps, taking 76·5 amperes at 22 volts. The two brake vehicles were equipped with Leitner generators rated at 45 amperes each (now rated at 50-60 amperes). There was also a self-contained coach equipped on the Leitner system in the train, the rated output of all three dynamos being 135 amperes, so that there was a margin of 58·5 amperes for charging the three batteries. The dynamo output was purposely chosen insufficient to keep the batteries healthy on daylight running, so as to test the system under limiting conditions. The train was put into traffic on March 17th, 1909, and has run continuously since then (with one break) in both fast and slow services. Several other trains running between London and Fishguard and elsewhere were also equipped in 1909 and 1910, and have run since the commencement almost without a failure. At first a looping system of connections was adopted, but it has been found preferable to substitute a simple bus-bar system, putting the whole of the coaches in parallel, with a lamp voltage regulator on each coach. The cost of equipping the experimental train (at 1910 prices) was £761 ; this could be materially reduced. The annual costs of lighting the train, averaged over 24 months, amount to £45, but under present conditions, and dealing with 500 coaches, a reduction of 29 per cent. would be made. The actual cost to the Great Western Railway of maintaining about 3,600 cells during 1909-10 represents 8¼ per cent. of their initial cost. The Leitner regulator costs only three or four shillings per annum, requiring cleaning about every 14 months. For 500 coaches the average annual out-of-pocket expenses should not exceed £6 per coach on the brake-vehicle system. With all coaches self-lit the cost might be £9, while with made-up trains on suburban and local services it could be reduced to £3-£4 per coach per annum.

Attempts have been made to assess the locomotive costs due to driving the generators. The problem is a difficult one, owing to the small proportion of the power to the total output of the locomotive. Under stated conditions, with an average locomotive draw-bar power of 277 and 284 H.P., the proportion assigned to the dynamos was 3·29 per cent. in the case of the experimental train, the belt power being 9·12 to 9·34 H.P., when all the lights were on and the batteries were being charged. Averaged over the whole year, the percentage of power required for lighting is given as 1·5 per cent. Had all the coaches been self-lit, the proportion would have risen to about 2 per cent. The total weight of the electric lighting equipment was 1·7 per cent. of the weight of the train with engine and tender, but calculated on the whole of the Great Western rolling stock, the proportion would be 2·75 per cent. In the case of the experimental train, the cost of energy to drive the dynamos is worked out at £13, and the cost of haulage of the equipment at £15, making a total of £28 per annum.

Taking the working costs already given as £45, and the locomotive costs as £28, and allowing for interest on capital at 4 per cent. (£30), and sinking fund at 3 per cent. (£23), the total annual charges for the experimental train amount to £126. The author believes these figures fairly represent actual conditions on a large system to-day, and the tendency is towards cheapening the apparatus.

If the wiring is carried out with good material and protected by suitable fuses, complete immunity from fire risks can be ensured.

THE FUTURE OF RAILWAY ELECTRIFICATION.

On Friday last we were, through the courtesy of Mr. Philip Dawson, present at the reading of a paper entitled "London to Brighton in 45 minutes: The Future of Railway Electrification," by himself, before the Royal Automobile Club. The paper was profusely illustrated, both by the lantern and the cinematograph. Mr. Dawson is, of course, full of his subject, and in the short space of two hours or so he conducted his audience in semi-popular vein through the whole field of railway electrification, commencing with the earlier railway schemes in the United States, such as the Baltimore and Ohio, Long Island, West Jersey. and Seashore, N.Y.C. & H.R. Railroads, and coming down to the more recent New Haven and Pennsylvania terminal electrifications.

In connection with the latter, which is a direct-current electrification, Mr. Dawson pointed out that all the main-line trains of the system entering New York were hauled by electric locomotives, 33 of these being required, each of a total capacity of 4,000 H.P. ; 250 local trains of the Long Island electrical system, and 150 main-line trains, enter the terminal each day, and, if our memory serves us correctly, we believe that it was recently officially reported that 99 per cent. of all the trains arrived on time.

From America, Mr. Dawson led his hearers to Germany, where the experimental work of the Prussian Government with the single-phase system was briefly referred to, and the Hamburg, the Dessau-Bitterfeld, and other lines in Saxony, Baden, &c., were referred to, the recent decision as to the Berlin railways being mentioned.

Progress in Austria, Switzerland, Italy, Sweden, and Holland next came under review. How great this progress is can be gathered from the frequent references which appear in our columns.

In the Austrian, as in the German, Swiss and Swedish electrifications, the single-phase system has been adopted, many of the railways coming under the designation of "main" lines.

The French authorities, after some years of quiescence, are electrifying on a large scale in the neighbourhood of Toulouse, and this also is a single-phase scheme, connected, we believe, with another one under Spanish control on the other side of the Pyrenees.

The author then touched briefly on main-line electric railway working in this country, mentioning the Tyneside lines of the North-Eastern Co. and the Lancashire and Yorkshire Co.'s electrical routes. The Midland Co. received credit for opening the first single-phase line in this country—its Lancaster-Heysham line—and lastly, the author dealt with the work for which he has been responsible, namely, the Brighton Co.'s single-phase operated suburban routes. A good idea of the overhead work and character of the Victoria-Crystal Palace route was given by means of cinematograph films taken during a journey on one of the electrical trains.

The Brighton Co., the author pointed out, were faced not only with the problem of suburban electrification, but also with the probability of electrically working in the future the route from London to Brighton ; the distance from Victoria is under 51 miles and the service already intense, there being 40 through trains each way per day. The termini at both London and Brighton are, moreover, so congested as to render any increase in service, without impracticable enlargements, impossible under steam conditions.

Mr. Dawson referred to the well-known satisfaction derived from the electrification of the South London route ; the results, he says, as regards economy of working, are, if anything, better with the single-phase than with the continuous-current system—at any rate the Brighton Co. have been encouraged to plan further conversions from Balham *via* Thornton Heath to Croydon and other adjacent localities.

While electric tramway competition has, no doubt, been the mainspring of railway electrification in this country, the author points out that a practical limit to steam locomotive power (about 1,500 H.P.) has been reached, while no particular limit has yet been set to the haulage possibilities of the electric locomotive ; moreover, these reasons for electrification have been supplemented by the much more cogent one, that electric traction represents a saving in working costs over steam working.

The case for long-distance electrification rests on cheap electric power being available, and the cost of distribution being kept within moderate limits ; the author considers that railways will be able in this country to purchase alternating-current at ·4d to ·45d. per unit delivered, and this will be the total cost to them, if alternating current is used, while if direct current were required the cost of transformation would under favourable conditions add another 50 per cent. The importance of the latter point can be gathered from the fact that the cost of energy represents about 50 to 60 per cent. of the total locomotive charges per train-mile.

As previously mentioned, a scheme for electrically operating the whole of the London-Brighton services is being investigated. The Eastbourne and Hastings trains would be electrically hauled as far as Lewes, and the majority of the Portsmouth trains as far as Worthing, steam traction completing the journeys. Towns not on the main route would be connected to it by motor-rail car services, and, the author says, the transformation would enable a 10 to 15 minutes' service to be given to Brighton, and a 20 to 30 minutes' service to all intermediate stations, and the traffic increase would be at least correspondingly large. It is proposed that the non-stop trains shall cover the journey from London to Brighton in about 45 minutes, and the stopping trains in about 60 minutes.

The surveys and calculations in connection with the scheme are well advanced, and Lord Bessborough, who presided at the meeting, subsequently stated that a report would be presented in three or four months' time, and would be most seriously considered by the directors with a view to its adoption.

Efforts to promote a discussion on the subject met with little success, the railway men (other than Mr. Forbes, general manager of the Brighton Co.) being either absent or quiescent ; the direct-current enthusiasts, who could have put up an excellent fight from the material contained in the paper, if present, also resisted an apparently tempting opportunity.

Mr. Forbes, who gave a few details regarding the working of the company's electrical lines, mentioned that the South London line traffic dropped from 8 million passengers per annum to 3 millions, with the advent of the L.C.C. electric tramways ; electrification revived the traffic to the original 8 millions in 1910, and this year the figure would be 10 millions. On the Victoria-Crystal Palace route an increase of 70 per cent. in passengers carried had occurred

since the opening of the electrical service in May, and extra rolling stock was needed to cope with the growing traffic.

He had not had a single complaint from South London passengers since the conversion, a very different state of affairs, he admitted, to that existing under steam traction. He added that the financial results following electrification had been most satisfactory, a point which we hope will appeal to other railway directors more convincingly than mere traffic facilities appear to have done.

THE MANCHESTER SMOKE ABATEMENT EXHIBITION AND CONFERENCE.

THE issue of the ELECTRICAL REVIEW for November 17th contained a preliminary notice of the opening of the Manchester and Salford Smoke Abatement Exhibition, with some details of the organisation and programme of the Conference to be held on November 21st and 22nd. A condensed report of the addresses and papers read at the Conference which are likely to be of interest to our readers is given below, together with a brief notice of a few of the exhibits.

The Conference was attended by the delegates of 24 municipalities and local authorities, and by representatives of eight scientific societies, and was opened by the Lord Mayor of Manchester in a brief speech of welcome.

MR. GORDON HARVEY, M.P. for Rochdale, delivered an address, as President of the Smoke Abatement League of Great Britain, in the course of which he stated that he was present as a manufacturer and a dyer, to assert that smoke from factory chimneys could be entirely stopped if three conditions were fulfilled:—

(1) There must be adequate boiler power; (2) there must be proper appliances for stoking and regulating the draught; and (3) there must be careful and constant supervision of the boiler plant by competent men. If these three conditions of work were fulfilled, his own experience enabled him to state that smoke could be suppressed on paying lines.

MR. E. D. SIMON, of Manchester, hon. secretary of the Smoke Abatement League, one of the voluntary associations already referred to, followed with a short exposition of the objects and aims of this Society, and summarised the four main lines of the League's present work as follows:—

1. To educate public opinion as to the urgency and practicability of smoke abatement.

2. To endeavour in all ways to extend the use of gas and electricity for power, heating and cooking purposes.

3. To stimulate the activity of local authorities with regard to the emission of smoke from factory chimneys, by the appointment of private smoke inspectors.

4. To help forward any legislative reforms that might be likely to render the efforts of local authorities more effective in securing smoke abatement within the areas which they controlled.

DR. DES VOEUX, the representative of the London Coal Smoke Abatement Society, followed Mr. Simon with a brief paper giving some facts and figures relative to the losses due to smoke. Exact measurements proved that London's loss of sunshine varies from 15 per cent in summer to 50 per cent. in winter, and it had been estimated that the pall of smoke which hangs over the metropolis of London nearly every day in the year costs that City directly and indirectly £5,000,000 per annum.

PRINCIPAL GRAHAM, chairman of the Smoke Abatement League, followed with a speech explanatory of the main provisions of the Draft Bill for strengthening the laws against Smoke, which the Executive Committee of the League has been busy with for some months. The aim of the Bill is to simplify the procedure in smoke prosecutions, and to introduce one uniform law for the whole country; at the same time grouping the smaller local Government areas together for the purposes of the Bill, and throwing one-half of the cost of maintenance of Smoke Inspectors upon the Local Government Board.

The Bill did not meet with a very favourable reception from the Smoke Reformers present at the Manchester meeting of the League, and it has been referred back to the Executive Committee for further consideration and amendment.

The physical evils and destructive effects of smoke were emphasised at the evening session of the Conference of Tuesday, November 21st, by PROF. COHEN and by MR. A. RUSTON, a Graduate of Leeds University. PROF. COHEN in an illustrated lantern lecture upon "The Effects of Coal Smoke," gave details of the results of numerous observations carried out in Leeds and the surrounding district, relating to the composition of soot, the amount of soot emitted from domestic and factory chimneys, and the acidity and the soot suspended in and around the City of Leeds.

The Wednesday morning session of the Conference was devoted to the reading and discussion of four papers dealing with the more practical and technical side of smoke abatement.

COUNCILLOR SMITH and CHIEF INSPECTOR FYFE, of the City of Glasgow, dealt with the subject of domestic smoke, and with the means taken in Glasgow to combat this evil. The solution offered by these gentlemen for the domestic smoke problem was the extended use of gas, both for heating and cooking purposes.

As no electrical engineers were present at the Conference, the gas interests had it all their own way, and no speaker dared to suggest that electrical heating and cooking apparatus could be seen in operation at the Exhibition, 10 minutes' walk away.

Two very practical papers upon "Steam Boiler Management," were then read by MR. G. B. STORIE, engineer of Mr. Gordon Harvey's works at Rochdale, and by MR. JAMES BIBBY, engineer of Messrs. Bibby Bros.' seed-crushing works at Liverpool, where the disastrous explosion recently occurred. This explosion, it may be noted, was a dust explosion, and in no way connected with the steam-generating plant.

Mr. Storie's paper was a *résumé* of the now generally accepted scientific principles of smokeless combustion in steam boiler furnaces, and while containing nothing new, was of interest as expressing the views of an engineer in charge of an up-to-date large steam-raising plant.

Mr. Storie, while a supporter of artificial draughts, is no believer in the use of steam jets for creating a plus pressure draught in the furnaces, as is shown by the following extracts from his paper:—

"Artificial draught is independent of atmospheric conditions, and may be produced by means of steam jets or by fans. The former are generally applied in the ashpit for forcing in air, which is made to pass upwards through the grates. The steam jet has also been used to deliver air above the fires, in the form of finely divided streams, with a view to mixing it with the gases arising from the fuel bed. This system of producing draught is very costly, as a large amount of steam is used by the jets, and it also introduces a considerable quantity of water which has to be heated and carried up the chimney."

A well-known authority has been combatting the mistaken use of steam jets for supplying air to boiler furnaces for some years, and it is satisfactory to find that some practical engineers are beginning at last to hold the same opinion.

Balanced draught, the latest device for providing a sufficiency of air in the furnace and flues, is described in the following paragraph:—

"Balanced draught has only recently been introduced, and it is a combination of the two systems last named. The vacuum created by the suction fan is just sufficient to overcome the resistance due to the flues, &c., when the forcing or pressure fan is setting up the undergrate pressure to burn the required amount of coal."

Balanced draught guards against the great inrush of air which occurs with the ordinary system of hand-firing, when the furnace doors are opened for cleaning the fires or for throwing on fresh fuel, and where this system of firing is used, will prove of considerable value.

Upon the question of training stokers for their work, Mr. Storie had also a few wise things to say, and the following extracts from his paper contain some interesting facts and figures relating to this side of the subject:—

"Poking the fires is one of the principal causes of smoke production, and although the author is aware that there are times when this operation cannot be avoided, when boilers are fired by hand, it is a practice which should be discouraged as much as possible as it has become almost habitual with many firemen, who have placed at their disposal, in the stoke-hole, clumsy tools of various forms which they do not fail to use.

"The effects of good and bad stoking are often very marked. Some years ago a prize competition in hand-firing was carried out at Sheffield, and the difference between the best and the worst man made a gain of 22 per cent. in evaporation, and 18 per cent. in boiler efficiency, with conditions exactly the same in each case.

"A great deal can be done towards the diminishing of smoke from hand-fired boilers, even in the case of varying loads, if there is sufficient draught under control to meet the maximum demand for steam, and the author considers that the conditions from a smoke point of view, in many works, might be considerably improved by the exercise of care."

The final extract from Mr. Storie's paper will be one dealing with the use of heat which is too often carried up the chimney with the waste gases, for preheating the air required for combustion of the fuel, on the bars of the furnace.

"In many boiler installations, the air required for combustion is heated by the waste gases after they have left the boiler flues. The circulation of the air is effected by means of a fan placed at the outlet of the economiser chamber, which draws the gases through the tubes of a heater situated over the main flue at the back end of the boiler. The air for combustion which is drawn into the heater circulates outside the tubes through which the hot gases are passing, on their way to the economiser. From the heater the hot air is conveyed in pipes to the furnace front, which is closed, and dampers are fitted to allow of the air being admitted both above and below the fires. The providing of this hot air, which attains a temperature of about 300° F., ensures a sufficiently high temperature being maintained during combustion in conjunction with intimate inter-mixture of the gases which, as has already been seen, is of the first importance for the completion of combustion and the prevention of smoke. The author has had some years' experience with a boiler plant arranged on this system and the results have been entirely satisfactory. On a carefully conducted trial, the plant showed an overall efficiency of 77 per cent., no smoke was produced, and the fan which at present delivers the waste gases into a chimney in the mill yard, is arranged in such a manner that it can be connected up to a steel chimney. This will be necessary at some future time, as the existing chimney will have to be removed to allow of buildings being extended. Owing to the absence of smoke, the new chimney will, of course, only require to be made slightly higher than the surrounding property. At the Hammersmith Central Power Station there is a similar arrangement to the one just described, with the exception that an additional heater is placed in the flue between the feed-water economiser and the fan. From this heater the air warmed

by the waste gases after they have left the economiser, is led in ducts to the heater over the main flue, to be further heated before it enters the furnaces. It is claimed for this two-stage system of air heating that the temperature of the air entering the high temperature heater is such that the fall in temperature of the gases passing through the heater is greatly diminished, with the result that a higher feed-water temperature is obtained, and the final temperature of the gases entering the fan is reduced to about 230° F.

"The quantity of steam required to operate an induced draught plant of moderate size, would not be more than 1½ per cent. of the total steam evaporated, and with the smaller-sized plants, the consumption will seldom exceed 3 per cent. When the fan can be driven by ropes or belting through shafting from the main engine, the cost of the power absorbed becomes even less, and in many cases it is hardly appreciable in the weekly coal bill. When air and water heaters are used, and the final temperature of the gases is reduced to about 275° F., the saving effected by the adoption of the fan draught, over that created by a chimney, is very marked."

Mr. Bibby's paper covered, to some extent, the same ground, and dealt largely with the scientific principles of good combustion, and the means whereby these can be attained in actual practice. He gave the following as the points which must be satisfied by the perfect machine stoker and furnace:—

"1. A means for regulating the coal fed separately to each furnace, so that the bed of fuel is level transversely.

"2. Independent provision for both the coking and fuel combustion processes, so that the correct proportion of air is supplied at the right periods, for these processes, and perfect combustion secured without requiring too great an excess of air.

"3. The furnace should be divided into a number of sections, and each section should be supplied separately with the correct amount of air, for the quantity of fuel that it is intended to burn per section, so as to prevent short-circuiting of air.

"4. The bars should be given a horizontal motion in order to travel the fuel, and the speed should be capable of alteration to suit variations of load and classes of fuel.

"5. While the furnace is working there should be no opportunity for air to escape into the flues except through the furnace. A door should be fitted beneath the back of the furnace so as not to depend upon the ash and clinker in the back chamber preventing air being drawn in.

"6. All the reduction gear should be machine-cut and in oil-tight cases, so that the machine will work under the adverse conditions found in many boiler-houses.

"7. An automatic means should be provided for discharging the ashes which fall through the grids into the trough bars, such as a triangular slide which periodically covers and uncovers parts in the bottom of the trough, and so allows the ashes to fall through into the flue."

To these might be added an eighth clause to the effect, "the air supply required for cooling the furnace bars and for supporting the combustion of the fuel on the grate must not be obtained by blowing steam into the furnace."

The Exhibition, as already stated in the preliminary notice, was devoted chiefly to domestic heating and cooking appliances—and as at Glasgow, the electric house and the gas house proved the most popular and instructive exhibits.

The heating, lighting and cooking, appliances for the electric house were supplied by the General Electric Co., Ltd., Manchester.

A tour of the various rooms afforded a demonstration of the value of electrical time and labour-saving devices—such as electric radiators, cookers, electric lighting, plate-warmers, hot-pad heaters, cigar lighters, floor sweepers, hair curlers, electric massage treatment, &c.

In addition to this exhibit the General Electric Co. had an artistic and instructive collection of lamps, heating and cooking appliances at Stands 18 and 25 of the Exhibition, the show of low and high candle-power Osram lamps being most notable.

Messrs. E. Bennis, of Bolton, had a representative exhibit of mechanical stoking and elevating appliances, also of a CO_2 recorder and fuel calorimeter.

Messrs. Johnson & Phillips had an exhibit of arc lamps on Stand 31, and were also responsible for the lighting of the main gangway of the Exhibition.

Messrs. J. Proctor, Ltd., of Burnley, at Stand 68, showed two types of mechanical stokers, and their elevating and conveying plants.

The Exhibition was well attended during the 13 days it was open, and we are informed by the secretary, Mr. Walter Cawood, that the results will be quite equal to those attained at Glasgow in the autumn of last year. The combination of Gas, Electricity and Sanitary Corporation Committees in promoting and running Exhibitions of this character, undoubtedly tends towards their success.

Now that Glasgow and Manchester have proved that Smoke Abatement Exhibitions can be made a financial success, we shall expect to see other equally smoky towns follow their example in this latest method of combatting the smoke nuisance.

NEW PATENTS APPLIED FOR, 1911.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by Messrs. W. P. Thompson & Co., Electrical Patent Agents, 235, High Holborn, London, W.C., and at Liverpool and Bradford, to whom all inquiries should be addressed.

26,464. "Construction of telephone cabinets and the like." W. Pickering and P. Pickering. November 27th.

26,483. "Electric incandescent lamps." S. O. Cowper-Coles. November 27th.

26,484. "Process for rendering iron surfaces non-corrosive." S. O. Cowper-Coles. November 27th.

26,485. "Electric boiler heater." J. Mann. November 27th.

26,495. "Method for generating power in primary motors." J. Esson. November 27th.

26,498. "Portable electric lamps." J. Macnab. November 27th.

26,511. "Electric arc lamps." W. Rogers and G. Rowe. November 27th. (Complete.)

26,516. "Telephone instruments." Telefon and Telegraphenbau Ges. G.m.b.H. (Convention date, June 8th, 1911, Germany.) November 27th. (Complete.)

26,530. "Plug and socket connections for electrical circuits." M. W. W. Mackie. November 27th.

26,536. "Electric lamps or the like." British Thomson-Houston Co., Ltd. (General Electric Co., United States.) November 27th.

26,545. "Method of and combination of apparatus for operating electro-magnetic track brakes." C. B. Tutt. November 27th.

26,548. "Apparatus adapted for use with an alternating current for signalling to a distance." Hartmann & Braun Akt.-Ges. (Convention date, December 21st, 1910, Germany.) November 27th. (Complete.)

26,551. "Electric regulators." H. Leitner. November 27th.

26,556. "Accumulator plate and a process and apparatus for manufacturing the plate." B. Zyttkowski. November 27th. (Complete.)

26,599. "Electric lamp." H. C. Garment. November 28th.

26,601. "Holders for incandescent electric lamps." J. Sax & Co., Ltd., and F. H. Collis. November 28th.

26,645. "Electric welding machines." British Thomson-Houston Co., Ltd. (Allgemeine Elektricitäts Ges., Germany.) November 28th.

23,661. "Magnesia or porcelain ring attachments or carriers for incandescent gas mantles." J. W. Lea. November 29th.

26,662. "Electrically driven clocks." T. T. Baker. November 29th.

26,666. "Motor-'buses and tramcars." H. J. Lawson. November 29th.

26,691. "Telephonic relays." C. H. Pritchard. November 29th.

26,717. "Telephone receivers." Siemens Bros. & Co., Ltd. (Siemens and Halske Akt.-Ges., Germany.) November 29th. (Complete.)

26,720. "Electric secondary cells and batteries." R. Pape. November 29th.

26,732. "Method of maintaining the furnace walls of electric induction furnaces." O. Frick. November 29th.

26,735. "Protecting devices for the cords of telephone plugs." E. Borck. November 29th. (Complete.)

26,756. "Means for cooling the rotor of electric machines, especially turbo-generators." A. J. Korner. (Convention date, January 4th, 1911, Sweden.) November 29th. (Complete.)

26,775. "Galvanic boot stud." L. W. Cooper. November 30th.

26,830. "Circuit systems for operating between manual and automatic telephone exchanges." Siemens Bros. & Co., Ltd. (Siemens & Halske Akt.-Ges., Germany.) November 30th. (Complete.)

26,842. "Primary cells with depolariser." Z. Szpor. November 30th. (Complete.)

26,854. "Processes of preparing metallic-filaments for incandescent lamps." R. H. Henderson. (Convention date, December 5th, 1910, United States.) November 30th. (Complete.)

26,857. "Cables for electric current distributing systems." C. H. Merz and P. V. Hunter. (Divided application on 4004/11, February 16th. November 30th.

26,861. "Electric conductors." W. S. Smith and W. P. Granville. November 30th.

26,862. "Generation of electric energy and apparatus therefor." W. S. Simpson. November 30th.

26,863. "Control of electric motor-generator sets." British Thomson-Houston Co., Ltd., and E. I. David. November 30th.

26,864. "Distribution of electro-motive power." G. W. Mascord. November 30th.

26,866. "Incandescent electric lamps." J. A. Scoular. November 30th.

26,874. "Method of and means for discharging electric accumulators or secondary batteries." A. M. Taylor. (Addition to 20,906, 1910). December 1st.

26,909. "Electric signalling devices and the like." T. S. Rogers. (Addition to 23,802, 1909.) December 1st.

26,913. "Electro-deposition of metals." S. O. Cowper-Coles. December 1st.

26,928. "Adjusting ring for ignition devices of internal combustion engines." R. Bosch (firm of). (Convention date, August 25th, 1911, Germany.) (Complete.)

26,929. "Interrupting devices for internal combustion engines." R. Bosch. (Firm of). (Convention date, November 7th, 1911, Germany.) December 1st. (Complete.)

26,980. "Attachment of tubular insulator carrying arms to telegraph and like poles." Bullers, Ltd., and E. H. Chambers. December 2nd.

27,006. "Trolleys for electric tramcars and the like." F. Sale. December 2nd.

27,010. "Switch apparatus for use in connection with the electric lighting and heating equipments of railway and other vehicles." Electric and Ordnance Accessories Co., Ltd., and J. Etchells. December 2nd.

27,011. "Apparatus for for measurement of electrical energy." E. T. R. Murray. December 2nd.

27,018. "Alternating current wattmeter." Callender's Cable and Construction Co., Ltd., and C. G. Watson. December 2nd.

27,034. "Electrical terminals or connections." K. D. Stevenson. December 2nd.

27,038. "Terminals for electric conductors." A. Catchpole. December 2nd.

Eccles and the Bill.—The T.C. has decided to support the Bill of the I.M.E.A. There was opposition at a meeting of the Council on December 6th, on the ground of municipal trading, and a motion not to support the Bill was rejected by 12 votes to 6.

Bootle Electricity Supply.—The electrical engineer presented to the meeting of the Corporation on December 6th a further report in regard to the provision of additional generating plant to meet the growing demand for electricity. The scheme involves an expenditure of £41,255, and it was approved by the Council.